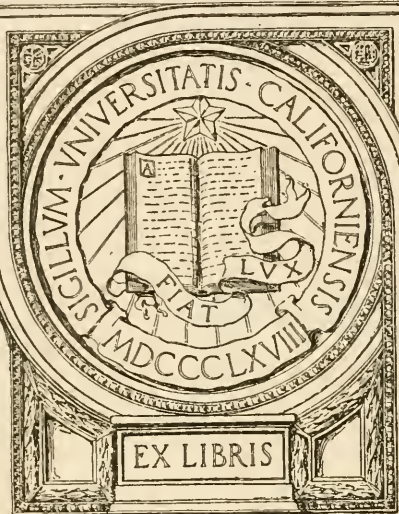




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**STUDIES IN
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ANIMAL FOODSTUFFS

*Thesis Approved for the Degree of Doctor of Science (Economics)
in the University of London*

ANIMAL FOODSTUFFS

Their Production and Consumption with a special
reference to the British Empire

*A Study in Economic Geography and Agricultural
Economics*

BY

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PREFACE

THIS work is the result of investigations conducted at the London School of Economics, with some small assistance from works in the British Museum Reference Library, between September, 1915 and September, 1918. Owing to the fact that it has been written entirely during the war period, it is not unnatural that the second part, dealing with consumption, should perhaps be coloured in some measure by the circumstances of food restrictions under which it was written. It is hoped that the bias thus given is not sufficiently marked to detract from the permanent value of this part of the work. Elsewhere war conditions have been largely ignored.

I was led to select the subject of animal foodstuffs for certain special reasons. I was brought up on a dairy farm in New Zealand, where, after leaving school, I spent several years in farm work ; and for a colonial, the questions concerning the production of, and the markets for, animal produce loom large on the horizon. Moreover, adequate supplies of the proper kinds of foodstuffs are of such vital importance to any nation, and the British home-produced supplies so strikingly deficient, that a subject such as that which forms the title of this thesis has an added fascination for Empire citizens of colonial origin.

So far as I am aware, the questions concerning animal foodstuffs have not been made the subject of any lengthened systematic investigation. An attempt has been made in this inquiry to survey quite impartially the productive resources of all important parts of the world in respect of animal foodstuffs. This has involved a great deal of detailed research. Throughout this part, and indeed throughout the whole of the investigation, the close relationship between animal foodstuffs and concentrated feedstuffs has been insisted upon. The main conclusion drawn has been that the supplies of animal foodstuffs tend at present, and are still more likely in the near future, to be deficient.

This has led to an enquiry into the economic position of animal industries in agriculture, into their costs of production, and into the economics of consumption in relation to production in respect of them. All these have been studied in their bearing upon future movements. No distinct attempt, however, has been made to deal with the subject of marketing which arises in this connection since the field appeared too wide and the questions too complex and technical for adequate discussion.

PREFACE

Certain conclusions have been stated with reference to the above topics as they arose, and these have been summarised at the close of the main parts of the work. On the basis of these results the questions relating to the supplies of animal foodstuffs within the British Empire have been briefly examined, and a number of observations and conclusions arising from the enquiry have been recorded in their proper place. This latter subject, which is indeed sufficient in itself to occupy the whole of a separate work, has necessarily been handled somewhat broadly owing to lack of space.

It has been a distinct aim in this enquiry to correlate in broad outlines in one important class of goods the economics of consumption with those of production ; and this constitutes, I believe, a new field of investigation in economic geography.

In conclusion I have to acknowledge my indebtedness to Professor Sargent, of the London School of Economics, for many useful hints and for sympathetic guidance, and to Mr. Headicar, the Librarian at that institution, for his never-failing efforts in obtaining a desired document or item from the collection of works in his charge.

E. W. SHANAHAN.

LONDON SCHOOL OF ECONOMICS.

CONTENTS

CHAP.	PAGE
INTRODUCTION	1
HISTORICAL SURVEY	4
<i>Part I. Production.</i>	
II. STATISTICAL MATERIAL	16
II. GENERAL SURVEY OF THE SOURCES OF PRODUCTION AND WORLD TRADE	21
III. PRODUCTION IN RELATION TO POPULATION AND CON- SUMPTION	35
IV. TEMPERATE SURPLUS-PRODUCING REGIONS	43
(a) United States ; (b) Canada ; (c) Argentina ; (d) other South American Countries ; (e) Australia ; (f) New Zealand ; (g) Eastern Europe ; (h) Siberia ; (i) Miscellaneous, Tem- perate Surplus-producing Regions. General Review and Summary of these Regions—p. 102.	
V. TROPICAL REGIONS	105
(a) Tropical Highlands ; (b) Tropical Lowlands.	
→ VI. ELABORATING—COMMERCIAL COUNTRIES	117
(a) Denmark ; (b) Holland ; (c) Sweden ; (d) Ireland.	
→ VII. DEFICIENT INDUSTRIAL COUNTRIES AND REGIONS	127
(a) Great Britain ; (b) Germany ; (c) France ; (d) Belgium ; (e) Austria-Hungary ; (f) Switzerland.	
→ VIII. ANIMAL INDUSTRIES IN THE PROGRESS OF AGRI- CULTURE	140
IX. SUPPLIES OF CAPITAL	148
→ X. AGRICULTURAL MACHINERY IN RELATION TO THE PRO- DUCTION OF ANIMAL FOODSTUFFS	151
→ XI. USES OF LAND COMPETITIVE WITH ANIMAL IN- DUSTRIES	157
(a) Wheat and Rye ; (b) Other Cereals ; (c) Potatoes (d) Sugar beet ; (e) Fibre crops ; (f) Forests and timber supplies.	
XII. COST PRICE AND COSTS OF PRODUCTION	172

CONTENTS

Part II. Consumption.

CHAP.	PAGE
INTRODUCTORY	193
I. THE CONSUMING POPULATIONS	195
II. THE RATE OF CONSUMPTION	202
(a) Meat ; (b) Dairy Products ; (c) Poultry and Eggs ; (d) Importance of Fish.	
III. THE RELATION OF ANIMAL FOODSTUFFS TO OTHER ARTICLES OF DIET	226
IV. ECONOMIC FACTORS THAT INFLUENCE THE RATE OF CONSUMPTION OF ANIMAL FOODSTUFFS	234
V. THE ECONOMICS OF THE PRODUCTION OF ANIMAL FOODSTUFFS IN RELATION TO CONSUMPTION— STUDIES IN INCIDENTAL PRODUCTION (PP. 257– 273)	252
SUMMARY OF CONCLUSIONS—PARTS I. AND II.	274

Part III. The Production and Consumption of Animal Foodstuffs in the British Empire.

I. SURVEY OF PRODUCTION AND CONSUMPTION WITHIN THE EMPIRE	278
II. THE OUTLOOK FOR THE FUTURE IN PRODUCTION	290
III. THE CONSUMPTION OF ANIMAL FOODSTUFFS IN THE EMPIRE	300
IV. THE EMPIRE'S TRADE IN ANIMAL FOODSTUFFS AND FEEDSTUFFS	304
SOME EFFECTS OF THE WAR UPON THE PRODUCTION AND THE CONSUMPTION OF ANIMAL FOODSTUFFS	310
BIBLIOGRAPHICAL NOTE	319
INDEX	322

The Animal Food Supplies of the World

I

INTRODUCTION

ANIMAL foodstuffs are now regarded as essential, together with cereals, in the dietary of all the great civilised nations of the world, except, perhaps, of the Japanese, who, however, have abundant supplies of fish available to furnish concentrated proteids, and fats. With the rapid advance of industrialisation and the massing of great populations in towns, subsisting upon foodstuffs brought from a distance, the trade in these products has assumed an importance which it never had before, and the question of supplies stands out with ever-increasing prominence.¹

Into the problems that arise from questions of supply and demand, or, more precisely, of production and consumption of animal food products, it is the purpose of the following chapters to enter. In the course of this inquiry it is proposed to define such products so as to include, first, meats of various kinds, including pork and bacon; second, meat products, such as extracts, lard and oleo; third, dairy products including whole milk, condensed and dried milk, and margarine, in addition to butter and cheeses; and fourth, poultry and eggs. Fish, which, it may be noted, can physiologically serve as a complete substitute for meat and dairy products in human diet, is intentionally excluded from the definition, since the geographical conditions of its supply are totally different. Fish, therefore, are discussed in this inquiry only as far as they affect the consumption of animal products.

It is to be noted that difficulties immediately arise from any arbitrary separation of animal food products from other food articles of general or special consumption by human populations. Cereals and other vegetable products, such as potatoes, and even fruits, though produced or imported primarily for direct human consumption, may also be partly used as feedstuffs for domestic animals. But "the proportion of grain fed to animals is not

¹ The world's production of meat, exclusive of China, has been estimated at about 50,090 million lbs. per annum. In calorie values, however, this is equivalent to but 1/14th of the world's rice crop and to but 1/6th of its wheat crop. In 1912 the export trade in meat (exclusive of live animals) has been estimated as amounting to 7.7 per cent. of the world's production. U.S. Dept. Agric. Office of Secretary. Rept. 109.

definitely determined, nor is it constant from year to year.”¹ This depends on the abundance of the crops and upon the market conditions of the moment. Obviously an abundant harvest of cereals and other food crops in any particular country, or in a number of countries connected by cheap transport, may well cause a large part of the surplus to be fed to stock, since the numbers of most domestic animals, especially of pigs and poultry, can be increased with comparative rapidity; and conversely, a poor harvest means that a high proportion, if not the whole, of certain crops is consumed as human food, and may even involve unusual slaughterings of meat-producing animals.² In other words, it is not possible to determine exactly what proportions of the various food crops will be consumed directly by human beings, or will be so consumed directly in the forms of meat and of dairy and poultry produce.

However, in spite of these facts, certain broad generalisations are possible. Maize, except in Mexico, Italy and certain Southern States in America, is produced and enters into international trade almost entirely as animal feedstuffs; the same is true of the poorer qualities of barley, and of the various kinds of seed and oil-cake, including the by-products from the crushing of tropical oil-seeds. Again, almost the whole of the enormous quantities of offals and by-products from the milling of cereals, such as wheat and rice, becomes food for domestic animals.

Oats, however, raise a difficulty of another kind in the demarcation of animal products from other articles of human food. Since oats are fed mainly to horses (which may be used either for agriculture or for transport and pleasure purposes), but are partly also fed to meat or milk-producing animals, and partly used for direct consumption as human food, it becomes a specially difficult matter to estimate the relative value of this cereal in the production of animal food supplies. Horses can scarcely be regarded as producers of these latter articles.³ Certainly farm horses are used chiefly for the cultivation of the land for crops which in their turn may be partly or entirely used to maintain cattle, sheep and pigs, but this is too indirect for serious consideration. There is really no end to the complications of the economic chain when contributing agents are traced backwards to their prime sources. Oats that are fed to horses, therefore, have little relation to the present inquiry. The same principle may be followed with regard to all such parts of ordinary vegetable and even animal food products as are diverted in manufacture⁴ or otherwise, from consumption as human food.

¹ U.S. Dept. of Agric. Bureau of Statistics, *Bulletin* 24, 1903 p. 82.

² See Henry C. Taylor, *Agricultural Economics*, 1905, pp. 145-7.

³ In certain continental countries, notably France and Germany, large numbers of horses are slaughtered for human food. The annual total is probably about half a million.

In the United States disused horses are converted largely in the cities into "tankage," which, when dried and powdered, is used as a feedstuff for pigs.

⁴ As, for example, in the manufacture of tallow, glycerine, soap, starch, commercial alcohol, alcoholic drinks, etc.

Nevertheless, in dealing with the question of animal food supplies for human consumption, especially on the side of international trade, it is impossible to disregard the production and the movements of cereals that are partly or mainly intended for feeding to cattle, sheep, pigs and poultry, and some estimate of the quantities so consumed is required for importing and exporting countries, and it is desirable to ascertain some working factor representing their value in terms of meat, dairy produce, etc.¹

Again, on the side of production, the two great classes of food products, namely cereals, together with potatoes, on the one hand, and animal products on the other, frequently do not make distinct claims upon the land utilised. There is much interlacing under more intensive farming, which is apt to defy clear analysis. Land may at one time be used in producing wheat for direct human consumption, later in producing maize for animal feedstuffs or barley, partly for beer and partly for animal feedstuffs, and finally be laid down to pasture for grazing animals. The reverse has often been observed in new countries in recent times; rough grazing land, used in the first instance only for pasturing sheep and cattle, has been put under the plough and turned into wheat land, and finally into mixed-farming land under rotation crops. It is difficult to determine in any given year the area of land which will be used for raising human food directly, or for raising it indirectly through animals. However, in a period of years in any particular country, though perhaps less so throughout the world, definite movements are to be noted in the areas of land devoted to these two purposes respectively. Even when this question is disposed of, there remains the competition upon available agricultural land for the production of wool apart from that of mutton, of fibres such as cotton and flax, and of timber. All of these vary from year to year. There are, moreover, other competing uses of a more limited nature to which land may be put, that vary over longer periods.²

To discuss and to make some attempt at disentangling these and similar points is the task that lies at hand. It will be necessary to add much concerning international trade in animal food-products, the technical organisation of agriculture, and standards of consumption.³ It must be added that, while the facts relating to the production and consumption of these products during the last half-century are tolerably complete, enabling some generalisations and conclusions to be made with fair accuracy, concerning future

¹ This varies with the different species of animals, *e.g.*, cattle, sheep, pigs, and with the different breeds of each species, and also, still more, with the age of the animals in the meat-producing class. A detailed discussion of this matter appears in Part II. Ch. v., below.

² Namely, the diversion of land from agriculture for public and private purposes.

³ The subject of marketing, which is of outstanding importance in a study of the relations between producer and consumer, has, by reason of its complex nature and for lack of space been only incidentally referred to in this enquiry.

developments, there must necessarily remain more or less uncertainty ; with regard to the developments in any lengthened future period, conjecture must play some part with scientific theory ; some questions can be reduced to simpler terms, but cannot be satisfactorily answered. Surprises have been known in the past, and may again easily come in the future. Who, for example, in considering these questions fifty years ago could have foreseen what refrigeration was destined to do for the trade in animal food products, or who but the keenest observers, viewing the position as it was thirty years ago, could have foretold how rapidly North America would cease to be an important beef-exporting area ?

For these reasons it seems advisable to limit any forecasts with regard to the future, to a time within the range of practical commercial considerations, not exceeding, say, twenty years from the present date. An added uncertainty arises from our ignorance concerning the settlement to be made at the close of the present war, or the changes in the customs tariffs of certain leading belligerent countries, that may follow the conclusion of Peace.

For convenience of terminology throughout this inquiry, food and foodstuffs will be used strictly in relation to human consumption, while feed and feedstuffs will be used in accordance with agricultural custom, strictly in relation to animals. For added convenience, the term feedstuffs will be used more particularly with reference to the concentrated materials, such, for example, as maize and oil-cakes that enter into international trade, while the term fodder (or fodder crops), will be used to cover hay, grass and green crops grown mainly on the same farms where the animals are kept. With regard to human consumption, also, the term concentrated foodstuffs will occasionally be used, with a view rather to convenience of expression than to scientific accuracy, to include the various foodstuffs of animal origin together with fish, in all of which the ratio of protein or of fat to carbohydrates and indigestible matter is especially high.

II

HISTORICAL SURVEY

FOOD products of animal origin have only in comparatively recent times in the history of mankind come to form a regular element in the diet of whole nations, and only still more recently have reached any importance in international trade. Within the tropics and warm temperate regions man has apparently always been, as he still is, with few exceptions, mainly herbivorous. Of the total population of the globe at the present day, about two-thirds live almost exclusively on plant products, supplemented in some cases by fish. The necessity for the more concentrated foods of animal origin has arisen particularly with the

advance of population towards the cold temperate regions, and the maintenance and continued progress of peoples in colder climates has been due in the main, perhaps, to the opportunities of obtaining such food supplies within them. The most vigorous and the most progressive peoples of our times, namely the nations of North-Western Europe and those descended from them in America and Australasia, are also the greatest consumers of meat and dairy products.¹

The earlier civilisations of which we have account arose in sub-tropical or warm temperate regions, and animal foodstuffs seem to have formed but a small portion of the total food consumed. In this they are to be distinguished from the semi-barbaric nomad tribes that roamed with their flocks and herds over wide areas and derived much of their food supplies from these animals. These were debarred from agriculture, except in very primitive forms, by their prevailing unsettled mode of life, which, while caused by their dependence upon animal food as their chief form of nourishment, was also made possible by the extra vigour derived from such food. Where large populations, however, collected on the plains and built up civilisations such as those of China, India, Assyria, Egypt, Greece and Rome, large supplies of animal foodstuffs, either from hunting or from the pastoral industry were impossible, and the chief reliance had to be placed upon grain crops raised on the fertile stretches along the banks of the rivers upon which the great cities were built. Indeed, until quite recently, wherever dense populations arose in any part of the world, animal products entered but little into the dietary of the great majority of the people. So long as such products were obtainable only by hunting or by local pastoral pursuits, increase of population brought with it as a corollary a decline in the proportion of animal products in the total food consumed.²

Down to the time of the development of the New World and, later, of Australasia, under European colonisation and settlement, Europe was the only continent where animal products figured largely in the food of any considerable populations. Europe, with its forests and natural pastures, its damper climate and its general freedom from great extremes of temperature, favoured the existence of extensive herds of meat-producing animals, which lived at first in a wild state and were afterwards gradually reduced in numbers, tamed, or replaced by domestic species, by the invading Aryan tribes. These Aryans appear to have begun as pastoralists, subsisting mainly on the produce of their flocks; and their ex-

¹ The consumption of meat in the countries inhabited by these peoples ranges from rather less than 50 lbs. per head per annum to over 200 lbs., with an average of about 90 lbs.

² The comparatively large proportion of slaves in a number of these populations of the earlier civilisations living at a lower standard of diet and efficiency, would have the effect of reducing the average level of consumption of animal foodstuffs or fish while maintaining it at a comparatively high level for the privileged ruling class.

tensive consumption of meat and milk may have contributed considerably to their marked vigour in pushing their way westward and south-westward as well as south-eastward. At all events, on reaching the well-watered grasslands and forest-clad uplands of Central and Western Europe their momentum and vigour may well have been increased by the great additions made to their food supplies, obtained not only from the hunting of wild animals, but also from their own domestic flocks through the abundance of natural vegetation. Hence it is in Europe that the greatest developments in the specialisation of domestic animals for the production of human food have taken place.¹ This development has been most marked in Western and North-Western Europe, where climatic conditions have at once been most favourable to the raising of domestic animals, and have also made concentrated foodstuffs necessary for healthy and vigorous human existence. From this comparatively limited region of the world have come all the more important breeds of draught horses, of sheep, and of meat and milch cattle, and nearly all the best breeds of pigs.

In tracing the general course of these developments in the utilisation of domestic animals in Europe, from the earliest times, it is found that some animals that at one time occupied a foremost place have lost it, and that some that were at one time used for several purposes, have come by specialisation to be used for one or two purposes only, with a great gain in efficiency for work or in quality of product. Thus in early historical times horses seem to have been employed little for agriculture, being used, by reason of their superior speed, mainly for war or for the chase. Such primitive agriculture as existed was carried out by means of human labour, often by serfs and slaves, or with the aid of cattle, which were also the principal draught animals for vehicles, much as they are in India at the present day. Under these conditions it was hardly possible for cattle to be kept especially for the production of meat and milk, or for these products to be anything but of an inferior quality from such animals. With the specialisation of the horse as a draught animal, cattle came in North-Western Europe, but only since the Middle Ages, to be kept more particularly for the supply of human foodstuffs, as now in England. The transition process is by no means yet complete in many parts of the Continent. On turning again to earlier times, it is found that sheep and goats were the chief sources of meat and milk, owing probably to their greater mobility and their better adaptation to the drier climates of South-Eastern and Mediterranean Europe. The fact that the centre of European civilisation and population moved from south-east to north-west within historical times accounts for the displacement of the goat among European nations from its former high position as a most important meat and milk producer. Ex-

¹ Asia, for example, which was the original home of the sheep, has the lowest density of sheep per square mile, while Europe has the highest among all continents.

cellent as the goat may have been in the economy of the small herdsman in a predominantly pastoral region with sparse population, its value disappeared with the growth of larger private holdings under more settled conditions and in regions where pastures are more luxuriant. Its utility was further reduced by the development of arable cultivation which arose in North-Western Europe, where larger domestic animals could easily be raised, and where, moreover, the products of forest and marsh in game, such as deer, wild pigs and wild fowl, could be relied on to furnish some supplies of fresh meat.

The pig, on the other hand, which is said to have been among the first animals to be domesticated by man,¹ has always been an important meat-producing animal, owing to its wide climatic range and its capacity of thriving on a great variety of feedstuffs. It must have existed in Europe with the earliest human settlements, often, however, in a semi-wild state, roaming the oak and beech forests. Indeed, until the rise of a widespread dairying industry on modern lines, such forests, together with rough pastures, furnished the principal supplies of feed-material, even for the herds of domestic swine.

With the exception of the turkey, imported from the New World, but domesticated in the Old, the various kinds of domestic fowl, especially geese, appear to have been known in Europe from early times.

The most remarkable fact in connection with the history of animal food products in Europe, is the general advance in quality, regularity and variety of supplies during the last two centuries. Game, formerly an important source of winter supplies, is relatively less abundant now than in the Middle Ages, but previous to the invention of firearms, about the 15th century, the difficulties of killing wild birds, and even animals, must have made this source of meat supply somewhat uncertain, at any rate, for the ordinary people. Apart, however, from game supplies, there has been a great advance in all directions. From a few kinds of animals producing flesh of poor quality several centuries ago, there has been progress to a considerable variety of specialised breeds, producing meat of the best quality yet known. There has been a great gain also in regularity and certainty of supplies² from one season to another, and from year to year. Under primitive and even medieval forms of husbandry, stock perished wholesale during bad seasons when fodder failed, and at the end of every summer there was necessarily a general slaughter of meat-producing animals that could not be carried over the winter. This meant that salt meat had to be the principal item in the animal foodstuffs consumed during the winter. With the great general increase in dairying, there has been an

¹ So stated on authority by Schmoller, *Grundriss Der Allgemeinen Volkswirtschaft*, Vol. I. p. 197.

² For a detailed account of the marked changes in this direction during the last fifty years, see Chap. xii., p. 182, below.

increase in the consumption per capita of dairy products, and scientific pig-raising as an adjunct to dairying has made supplies of bacon and pork available for consumption on a scale previously unknown. Winter dairying, as also winter stock-raising, has developed, especially within the last 100 years, furnishing supplies of fresh products instead of salted, for consumption during the winter season.

A survey of the part played by animal products in the history of the dietary of European peoples from earlier times shows several well-marked phases.

The first is that marked in Greece, Italy and neighbouring countries, by the dominance of the Greek and Roman peoples for several centuries, both before and after the commencement of the Christian era. Agriculture and animal husbandry were held in high esteem by both these peoples. The existence in both Greece and Italy of mountain slopes close to populous plains favoured the extensive rearing of sheep and goats for clothing material as well as for meat and milk, while the fairly advanced state of cultivation in the plains made it possible to raise a surplus of cattle for food above the requirements for draught purposes; but as population increased, there must have been a relatively smaller quantity of meat available from such sources. At no time, however, do these peoples seem to have been great consumers of either meat or dairy products except perhaps of cheese. Fish was a most important article of food in those sea-girt peninsulas and islands, and made meat from animals less essential to those who lived, as many of them did, within reach of fishing waters.¹ The warmer climate, in any case, made the lighter forms of proteid food, such as fish, cheese and poultry, more suitable in the dietary than animal's flesh, and at the same time rendered fats more or less unnecessary. The general cultivation of the olive supplied an oil that was capable, as it is now in Mediterranean countries, of taking the place of butter and animal fats, used so freely at the present day in colder climates.

Throughout Europe, north of the Alps, the conditions during classical times naturally showed some differences as compared with Mediterranean countries. These differences remained until the beginning of the Middle Ages. Wild animals, killed in hunting, probably furnished an important part of the meat supplies of the population. Some domestic animals were reared on pastures, but with the exception of pigs, not mainly for food purposes. Grazing land was occupied in common, and the animals received little more than the simple herdsman's care. Meat supplies were probably irregular—excessive at one time and deficient at another. The stronger classes among the populations seem to have consumed fairly liberal quantities of meat, while the lower orders had but little of it.

¹ The preserving of fish by drying in the sun and the making of cheese were both apparently practised even in prehistoric times. L. Bourdeau. *Histoire de l'Alimentation*, 1894, Chap. iii.

The period known as the Middle Ages may conveniently be taken as marking off a second stage. Before, as well as during this time, there was a continuous gradual shifting of the geographical centre of European population northwards from the Mediterranean, and westwards towards the Atlantic. This period, which saw the rise of large and wealthy trading towns in Italy, Germany, France, the Netherlands, and Southern England, while the rural districts remained comparatively poverty-stricken, was largely filled with wars, both civil and foreign, in the countries named. Hunting and warfare were the chief occupations of the nobility, who took little interest in agricultural pursuits. At the same time, the constant insecurity of movable property in most countries in consequence of wars and unstable governments, directly discouraged peaceful agriculture, and made its development generally impossible. Only in some more favoured countries, where peaceful conditions were maintained during longer intervals, such, for example, as England, Flanders and Spain, was progress made in animal breeding, notably of sheep, wool being then in great demand. Relatively to the population game seems to have been quite abundant, but was appropriated chiefly by the feudal nobility or by the wealthier townsmen. These two latter classes, with their dependents and retainers, apparently lived very well, and consumed great quantities of meat, poultry and even dairy products of which the ordinary peasant and serf population saw but little.¹ During the winter, meat supplies were derived either from game which, with the large forests still standing and the relatively sparse population, was fairly abundant, or from the animals killed at the end of the summer, and preserved by salting. Even as late as the end of the 16th century the use of winter fodder crops and the systematic enclosure of meadows for hay, making it possible to carry cattle stock in proper condition through the winter, do not seem to have been widely practised. Man was still very much the slave of the seasons. During the later Middle Ages the gradual clearing of large areas of forest, the introduction of firearms, the extermination of beasts of prey in the more populated parts, and the more settled nature of governments, made both general agriculture and animal raising more widespread and more productive, thus marking a distinct advance upon the earlier part of the same period. A summary of the position during the Middle Ages is difficult by reason of the differing conditions at different times, and in various countries at the same time. In general, it is to be noted that climatic conditions made more animal food necessary than among the Greeks and Romans of classical times, especially when it is remembered that a much larger proportion of the population lived beyond reach of sea-fisheries, and that vegetable oil was much less available for

¹ According to Schmoller, the consumption of meat in Frankfurt on the Main and Nurnberg in the early 14th century was between 120 and 150 kg. per capita, or more than double the present consumption in England, *Grundriss Der Allgemeinen Volkswirtschaft*, Vol. II. p. 132.

the majority. Class distinctions everywhere apparently accounted for considerable differences in the amount of animal food in the dietary; the quantities available ranged from comparative superfluity for the feudal nobility in the earlier, and for the landowners and wealthier townsfolk in the later centuries, to a mere subsistence level, and in times of distress, even less than that for the agricultural workers and poorer classes generally. It may indeed be fairly safely said that these latter classes were more or less habitually underfed, particularly in animal foodstuffs, except during times of unusual abundance. The prevalence of the common-field system throughout Europe with the mingling of the herds of the different cultivators in each village community, was a positive bar to the scientific breeding and improvement of farm animals, besides encouraging the rapid spread of animal diseases. The change to the modern intensive forms of agriculture and animal husbandry, which enabled a large supply of animal foodstuffs to be produced from a limited area, came only after the abolition of this system in a later time. It is interesting to note that the first steps towards high-farming methods were made in Flanders in the 15th and 16th centuries.¹

Beginning with the 17th century, a third stage in the development of European supplies of animal foodstuffs is to be distinguished. The period covered by this stage lasted till about 1875, when cheap transportation and refrigeration made the movement of large supplies from one country to another possible. Before this date each country had to rely almost entirely upon its own local production of animal foodstuffs, since no practical means of transport existed for conveying meat cheaply over long distances without great risk of loss. Live animals could be driven, or even conveyed (after the introduction of railways), but these methods of transport were of limited use. Supplies were still largely localised, so that abundance might exist in one region while in another, at a distance, there might be a great shortage. Down to the middle of the 19th century also, tariff barriers actively hindered free movement between one country and another. Throughout this later period, as in the Middle Ages, supplies of meat and dairy produce do not seem to have been regularly sufficient to furnish all classes, including the peasantry, with an adequate quantity of animal foodstuffs, except during the height of the season. Great improvements were made, especially during the 18th and 19th centuries, in stock-breeding, but the increase in population tended to overtake advances in animal husbandry. Large areas, formerly covered with forest or otherwise unoccupied, had been cleared, and game thus became rather a luxury for the wealthy than a continuous source of food for any important part of the population. Grazing lands came to be occupied for agricultural purposes as the advancing population made greater grain supplies necessary for its subsistence.

¹ *Encyclopedia Brit.*, Edition 1911. Article on Agriculture, Vol. I. p. 389.

The Enclosures of Common Land in England are a clear example of this process. Wars, though still frequent and widespread enough, became less fatal, with the greater stability of governments, to developments in agriculture and animal husbandry. The 18th century saw the introduction of rotation farming on a permanent and scientific basis, furnishing fodder and root crops as regular winter foodstuffs for live-stock. The carrying capacity of the land per acre was thus greatly increased, and the necessity for killing off cattle and sheep at the commencement of each winter gradually disappeared. Supplies of meat throughout the year were in this way made much more regular. Horses came during this period to be used more generally for farm work, with the consequences that cultivation became more efficient, and that cattle were set free as meat and milk producers. As the 19th century advanced, grain came to be transported more cheaply by land and sea, so that not only was land, taken for cereals, once more set free for animals, but also animals could be raised with the aid of imported materials on land that would otherwise have been incapable of supporting them. As railways came into working order, live animals could be conveyed over longer distances by land than it had been possible to drive them without serious loss in condition. With the improvements in steamships, from 1840 onwards, live animals and fresh meat could also be carried short distances by sea, as, for example, from the Continent of Europe to England. This was, in reality, the first example in the world of any extensive and continued trade in fresh animal foodstuffs. Great Britain, having gained great advantages by the firm establishment of manufacturing industries before and during the Napoleonic Wars, was in advance of all other countries, and naturally increased rapidly in wealth and population. Since also the area of agricultural land was strictly limited, importations of grain from Europe, which had begun in the 18th century, were followed by importations of meat in the 19th century. In this connection, it is interesting to note that pig-meat was imported before the days of refrigeration, in larger quantities than any other kind of meat, owing to its being preserved mainly in the salted form. This trade was favoured by the fact that London, which was always the most populous centre in the country, lay opposite, and within easy reach of the chief meat-producing countries of Europe, namely, those in the lowlands round the North Sea. Further, with the decline in population in Ireland after the potato famines and the consequent heavy emigration thence to the New World, a surplus of meat and dairy produce became available from that country for the rapidly developing markets of Great Britain. Down to 1875, and indeed to the close of the 19th century, continental European countries remained largely self-sufficing in animal foodstuffs, except so far as certain not very considerable quantities of imported feedstuffs were fed to animals and thus constituted indirect imports of meat and dairy produce. On the Continent industrialisation was nowhere so marked as in England,

and the areas of agricultural land available for food production were much greater in proportion to the population. Moreover, the continental peoples seem to have been accustomed to living at a lower standard—at all events, to have consumed less animal food-stuffs per head—than the British. It is not, therefore, surprising to find that till the last quarter of the 19th century continental countries were more agricultural than industrial, and that some of them, notably Germany and the Netherlands, had surplus grain and meat and dairy produce for export, for which Britain was the most considerable customer.

During the period under review North America and Australia were settled by Europeans and developed by them. The former was very rich in game which supplied an important part of the meat diet of the early settlers, as it had done exclusively for the Red Indians before them. European breeds of sheep and cattle had been introduced at an early date by the Spaniards, and later on by the English colonists. These multiplied rapidly under the favourable natural conditions, but the quality standard seems to have been low. However, by 1840 the ratio of meat-producing animals to the population was such that the per capita consumption of meat was extraordinarily high—higher than it has ever been since that time, according to American authorities.¹ Owing to the much greater rapidity of development, it would appear that that part of North America occupied by the United States has, during the course of the 19th century alone, passed through the various stages observed in Central Europe between the early Middle Ages and the present time, in the matter of supplies of food-stuffs. The earlier phase of comparative abundance of meat, with considerable quantities of game, has given place to that of comparative shortage, characterised by the absence of game except as a luxury; but the earlier period which in the case of Europe is now distant about five centuries, is distant in North America less than one century. In Australia, also, though game was never very abundant, there were pasture lands available for sheep and cattle, once the fringe of settlement crossed the eastern dividing range. The pastoral industry advanced rapidly during the 19th century, owing chiefly to favourable natural conditions, but partly also indirectly to the gold discoveries which caused a number of miners and adventurers to turn to the easiest form of agriculture, namely, the pastoral, when the “rushes” were over. In the third quarter of the 19th century meat, especially mutton, was extraordinarily plentiful and cheap, and was, in fact, a sort of by-product from the production of wool and tallow for export. The per capita consumption of meat was enormous.² The introduction of refrigeration has altered the position in Australia by relieving the

¹ U.S. Dept. Agric., Bureau of Statistics, *Bulletin* 55, p. 70.

² Even at the present time the estimated meat consumption per head in Australia is more than double that of Great Britain, but the consumption of fish and of cheese per head is much lower.

home market of the surplus at profitable prices, and has incidentally raised the local price and probably to some extent reduced the consumption per head.

The year 1875 marks the commencement of the recent period which continues to the present time. During these forty years the most remarkable developments ever known in the history of the world's production, distribution and consumption of animal foodstuffs have taken place. The rapid improvement and cheapening of railway and of steamship transport, the introduction of refrigeration on ocean vessels, of the refrigerator car on long overland journeys and of cold storage in the ports and in the large centres of production and of consumption have all combined to make the whole civilised world, except for tariff barriers and international wars, one market for meat and dairy products ; so that there is now little variation in the regularity and prices of supplies from season to season and from year to year. These forty years also have seen the opening up, as fields for the production of animals and animal foodstuffs, of areas of productive land, together larger than the whole of Europe, first in North America, later in Australasia and Argentina, and finally in Siberia. Moreover, from the same regions the world has derived a great surplus of animal feedstuffs, including North American oats, cotton-seed and linseed, Argentine maize, linseed and oats, and Russian and Siberian barley and seed-cakes. As a market for such surplus products Great Britain has maintained the lead she gained during the earlier quarters of the 19th century. Indeed down to the beginning of the present century Great Britain practically monopolised the world's surplus of animal foodstuffs, and took the more important part of the world's surplus of animal feedstuffs. Only during the last two decades have other countries in Western Europe begun to take any appreciable part of the former, or any considerable part of the latter. So far as the live-stock in all the newly settled countries is concerned, it is remarkable that the foundations of improved stock of meat-producing animals and of dairy cattle have been, in practically every instance, the British thoroughbred strains. This is due partly to the lead taken by Great Britain in stock-breeding in the 18th and 19th centuries, and partly also to the fact that the new countries were settled either by English-speaking people or under British influence. At all events, the world in general during this recent period has taken advantage of the improvements made earlier by the British.

When the first rush of cheap, ungraded exports of animal products was over, consumption commenced once more, after about the year 1895, with the filling up of new countries and the increase in population and purchasing power in North-Western Europe, to adjust itself to production. Thenceforward specialisation began to appear in all producing and exporting countries. Each region has tended to adopt more particularly that form of animal industry for which it is best adapted, and to evolve crossbreeds most suitable

to local, climatic and other conditions. The perfecting of the separator and the establishment of butter and cheese factories have not only enormously increased the quantity and the quality of the output of dairy products, but have also made widespread dairying for export possible in new countries of dear labour, where otherwise the industry would have been impossible. Thus Denmark, Western Siberia, South-Eastern Australia, Eastern Canada, Holland and New Zealand have specialised more or less in dairy products, the first three in butter, Eastern Canada in cheese, and the two last in butter and cheese; Denmark and Eastern Canada have specialised in bacon pigs, Holland in pork pigs, and the maize belt of the United States in lard pigs. Similarly also the American prairie uplands, Argentina and Queensland, with extensive areas of "ranching" lands, have specialised in beef-production for export; the semi-arid regions of Australia and Argentina in mutton and wool sheep; and New Zealand with an abundance of succulent vegetation, in high-grade mutton, and especially lamb. A number of developments have rapidly caused the elimination of cheap and inferior products. The most important have been improvements in pastures and fodder crops, and in the various breeds of cattle, sheep, pigs, and poultry. Progress has been stimulated also by labour-saving inventions of greater efficiency in the form of dairying machinery and appliances, of the installations of meat-freezing and meat-packing establishments, and, above all, of means of transport and of storage already referred to. The only exception, perhaps, is found in Siberia, where development has been latest, and even there producers are fast coming into line with the rest of the world. In the British market the distinction between the higher-priced home product and the so-called inferior imported article tends to disappear, except in the case of mutton, which cannot be carried overseas by the chilled process. In the case of dairy products, especially butter, owing to greater specialisation and a fuller utilisation of machinery abroad, the imported article tends even to be superior to that produced at home.

In the last decade consumption seems everywhere to have been overtaking supply, even though tariff barriers have so far largely kept the industrial regions of Central Europe, notably in Germany, out of the world's markets as competitors for the available supplies. Prices have advanced distinctly as a consequence, and this has been reflected in a sharp rise in land values in the newer surplus-producing countries. Already the large-scale cattle-ranching industries of North America and of some other regions show signs of disappearing, owing to the advance of settlement, and the utilisation of the land for arable farms. This in itself is a remarkable fact, and is analogous to a similar far-reaching change in the earlier history of animal food supplies, namely the disappearance of game as an important source of food supply. Even in Australia the large sheep "squatter" is retreating in favour of the smaller wheat grower and dairy farmer, behind the line of 12-inch rainfall,

where, as a wool producer, pure and simple, he is probably safe for some time to come. All these changes, as shown in various countries, are due to the same prime cause, namely pressure of population, which, as we have seen, in earlier times turned hunting from a means of livelihood into a luxury pastime.

What are the tendencies of the present and of the near future? Land suitable for cultivation and settlement or even for pastoral pursuits is now more or less limited within the temperate regions of both hemispheres. In the meantime, in spite of great wars, the consuming capacity of industrial Europe and of industrial North America continues to increase faster than local supplies can keep pace with. New industrial regions enter as great consumers. Desperate efforts are being made in such regions to maintain and even to raise the standard of living. The newer countries, which a generation ago, unloaded huge surplus consignments on the British market exclusively, are now in some cases themselves filling up with their own population; and the output of animal foodstuffs relative to the world's consuming population and increased standards of consumption, grows steadily smaller.

PART I.—PRODUCTION

CHAPTER I

STATISTICAL MATERIAL

IN discussing questions relating to the production of animal foodstuffs, some preliminary cautions relating to statistical material are necessary. The first concerns the enumerations of farm animals as published for different countries from time to time. For some countries only estimates are available, and even in the more advanced countries it is hardly possible, under the existing methods, to obtain quite accurate figures. Again, the methods of conducting enumerations and even the time of the year at which they are made, differ from one country to another, so that the results are of modified value for comparative purposes. Finally, distinctions are not ordinarily made between those animals that are kept for food-producing purposes and those that are not, such, for example, as breeding-stock in all countries, specialised wool-producing sheep in Australia and elsewhere, and draught cattle in India and in a number of other countries, that produce quite inferior meat (consumed locally, if at all), and nothing for export trade except hides and bones. For the purpose of accuracy, in dealing with actual and possible food supplies, all such classes of animals should be clearly distinguished from the rest. Breeding-stock, however, though of little value for immediate food supplies, are of the greatest positive significance in relation to future supplies. Indeed, their numbers may be taken as some index of future developments. In this sense they have a positive value, while the other classes above mentioned have but small direct value.

The second caution under this head is perhaps even more important, because generally overlooked. It is to be noted that the enumerations of cattle, sheep and pigs taken in different countries, and even in the same country at different times, do not, for comparative purposes, accurately indicate the amount of meat, etc., available for home consumption or export, even when allowance is made as suggested above. Improvements in breeds of animals and in methods of feeding have certainly resulted in a much more rapid maturity of beef-cattle and similarly also of mutton-sheep and of all kinds of pigs. The net effect of such changes is to make the turnover, so to speak, from a given number of animals much more rapid. It is obvious that if a steer can be finished in two years or less, where formerly it took, say, three years to bring him to the same weight and condition, for practical purposes the meat production per unit enumerated (breeding-stock being omitted), has increased by 50 per cent. The average composition and stage

of maturity of flocks and herds of animals requires care in comparative enumerations ; a million sheep, three-quarters of which are full grown, are clearly of greater value as immediate potential meat producers than a million sheep, three-quarters of which are lambs. The same care is also necessary in comparing estimates for different countries ; a herd of low-grade Brazilian stock, for example, each yielding, say, 400 lbs. of marketable meat, cannot be regarded as having the same unit value as a herd of English high-grade beef-cattle, each of which yields, say, 800 lbs. On the other hand, it is to be noted that, as a rule, any speeding up of the turnover from a given number of meat-producing animals entails an increase in the numbers reserved as breeding-stock.

Some caution is equally necessary in considering prices, which cannot be taken as they stand, without reference to changes in the general level of prices. This level, as shown by index numbers compiled in different countries, moved steadily downwards from about 1871 to about 1895, and since then has moved steadily upwards with a fairly rapid rise from 1908 and a startling rise since the outbreak of the present war. In dealing with animal food prices, it seems reasonable to note deviations from the general level, whether upwards or downwards, rather than to consider these prices as representing essential changes by themselves. The numbers thus obtained may be called differential index numbers. Unless some such method is followed, undue weight may be given to the changes in the price levels of meat and dairy produce, owing to the fact that the cost of these articles forms a relatively high proportion of the expenses for the total dietary.¹ The following table, compiled from the Board of Trade Index Numbers of Retail Prices in London, may serve the purpose of illustration.

Year.	Index of Meat.	Difference.	Index of Dairy Produce.	Difference.	Index of Bread, Flour, Cereals, and Potatoes.
1906	100	—	100		100
1905	101.1	—1.3	98.5	— 3.9	102.4
1910	113.1	+3.5	104.1	— 5.5	109.6
1913	120.9	+4.7	109.3	— 6.9	116.2

The rise in the Index Numbers of cereal foods and potatoes may be taken as representing the increase in the general level of the prices of the simple staple food materials, and the differences between these numbers and those of any commodity or group of commodities, such as meat or dairy produce, represent more exactly the true changes in the price-level of that commodity. These differential index numbers appear in the table above in a column next to the index numbers of the commodities. It will

¹ Meat and meat-products account for more than one-third of the total food expenditure of the average European and American family, while the addition of dairy products makes the combined cost well over one-half of the total.

be noted that meat advanced rapidly in price after 1905, while dairy produce fell relatively between 1900 and 1913.¹

The points above discussed cannot always be referred to in the course of the following chapters, but they require to be borne in mind throughout whenever live-stock statistics and prices are under discussion.

With regard to statistical tables of production and export, it is, in practice, found less necessary in dealing with animal produce to take figures for an average of successive years (instead of for single years) than it is in dealing with crop products. The latter especially in countries subject to intermittent favourable or unfavourable weather conditions, vary considerably from year to year, and three or five-year averages are almost necessary to give a clear account of periodical changes in production and export or import trade. Single-year totals selected at regular intervals may convey an entirely wrong impression.

The production and export of animal foodstuffs do not vary so much in yearly periods, according to the commoner irregularities in the weather. Only occurrences of an extraordinary nature, such, for example, as a protracted drought in Australia, have a marked effect. Indeed unfavourable weather conditions, by diminishing the available quantities of fodder and feedstuffs, may at first increase rather than diminish the output of finished animal produce, by forcing a number of animals into the produce market, that would otherwise have been fed longer. The effects are thus postponed and averaged somewhat. It is to be noted, however, that food products from quickly-maturing animals are more sensitive in their quantity to favourable or unfavourable weather conditions than those from others. Thus lamb and pig-products are more sensitive in this way than mutton, and mutton than beef. Dairy products are somewhat sensitive in short periods to weather conditions as affecting supplies of pasture and succulent fodder.

Wherever changes in supplies are under consideration, it should be noted that quantities are a much more reliable index than are values. The quality of animal produce throughout the world has certainly advanced in recent years, but prices have advanced much more rapidly, and the effect of taking values alone would be to exaggerate changes out of all due proportion. When it is necessary to use values as a common denominator for a basis of comparison between one time and another, of a number of different articles taken together, it is best to reduce them by means of the index numbers of the wholesale prices, say, on the British market. Thus the index of wholesale prices for meat and dairy produce on that

¹ According to figures given in the Statistical Abstract for the United Kingdom, 1915 (Cd. 8128), the rise in the price of imported wheat in the period 1900 to 1913 was 21·8 per cent., with which the corresponding increases for imported food articles of animal origin may be compared. The latter were as follows :—Bacon, 72% ; beef, 11·7% ; mutton, 19% ; butter, 12·6% ; cheese, 21·4% ; eggs, 39%.

market advanced from 100 in 1900 to 119.6 in 1913, and the total value of the supplies of these products taken together should be multiplied by the fraction $\frac{100}{119.6}$ before comparing with the total value for 1900. It follows that the increase in the exported and imported supplies in any recent period is not so great as trade figures expressed in values represent it.

In dealing with the trade returns certain difficulties arise owing to incompleteness of detail, and to differences in classification between the official publications of different countries. It frequently occurs, for example, that exports of meat are entered as "unenumerated"; these may consist of beef, mutton, pig-meat, edible offal, or oils and fats in varying proportions. In both import and export trade returns, but especially in the former, all animal oils and fats are sometimes classified together in one group, so that tallow is not distinguished from edible products. In this connection a peculiar feature is apt to appear as between the import and the export trade of some countries; oleo and kindred products, used largely for making margarine, are classified with meat products in the import trade, but when manufactured into margarine, fall into the category of dairy products in the export trade. The trade in live food animals must, of course, be taken together with that in meat in considering any particular area. Distinctions are not always made between cattle, sheep, pigs, dogs, and poultry which are sometimes entered together as "other animals" after horses. In strict accuracy it would also be necessary to distinguish in international trade mature animals that have been fattened and are destined for immediate slaughter, from young animals that are intended to be kept for some time as stores in the importing country; this latter class of animals consists mainly of cattle, owing to the ease with which they can be transported and the much longer maturing period required by them than by sheep and pigs. Unfortunately, however, statistics do not always distinguish mature from immature cattle in international trade, though the values which are usually given serve as some indication as to the average quality. With regard to pedigree breeding-stock—which have a very high average value¹ and which are, of course, not primarily intended for conversion into meat—the international trade is relatively small. The exports of such animals are mainly from Great Britain, which otherwise has an insignificant export trade in live animals. In considering the movements of live animals in international trade, horses can generally be excluded from discussion in this inquiry. It should be noted, however, that part of the export trade in live horses of such a country as Great Britain, where horse-flesh is not ordinarily consumed, may consist

¹ The average value of the cattle exported from the United Kingdom in 1913 was £48; of the sheep, £11.7, and of the pigs about £14. Agric. Statistics 1913, Part IV. (Cd. 7551), pp. 295-6. These values are of course much above the ordinary prices for these animals.

of discarded animals which are destined for slaughter as food in the importing country.

In estimating the net balance of trade of a given country in animal foodstuffs together with the materials used expressly for their production, the most convenient common denominator for all the products concerned is that of values, and this is used occasionally below ; though this method cannot safely be used for comparing the position in one period with that in another, it has some value for the purpose of affording a summary view at a stated time. When comparing the position of different countries in the same period by this method, it must be remembered that the value of the given consignments of commodities are, on the average, lower in the exporting than in the importing countries, so that the total value of the recorded exports of a certain class of products will be smaller than that of the recorded imports. It is impossible, however, to expect refined accuracy in international trade returns ; it happens even that not inconsiderable discrepancies appear between the total recorded exports and the total recorded imports of the same article, even when these are expressed in quantities.

CHAPTER II

GENERAL SURVEY OF THE SOURCES OF PRODUCTION AND WORLD TRADE

WHEN the various sources of production of animal foodstuffs are considered, as they exist at the present day, it is seen that practically the whole of the world's output of these articles is raised within the temperate regions, and the same is true of practically all the animal feedstuffs of international trade. Those parts of the earth's surface that lie beyond the Arctic and Antarctic circles may at once be excluded. The only food-producing animal found in these cold regions is the reindeer of the Northern Arctic plains, which furnishes an important element in the food supply of the scanty, semi-civilised Eskimo population, but in no case yields anything of food value for export purposes. The tropical regions, taken in the climatic sense, may also, with one or two exceptions, be excluded. The peninsulas and islands, as it were, of temperate climatic conditions, formed by the upland elevations continued equatorwards from the adjoining temperate zones, and by the isolated plateaus and mountain peaks, situated within the tropical circles, are regionally distinct from the neighbouring lowlands, and are to be considered separately in a question where climate plays so important a part as it does in the present one. Certain parts of the tropical regions are exceptional in so far as they export products that furnish animal feedstuffs, of which the most striking are: first, tropical oil-seeds and copra; second, a small quantity of cotton-seed cake from cotton grown in tropical countries; third, molasses from tropical sugar-cane plantations in the East and West Indies, in India and Northern South America. The tropical regions, as defined above, export practically nothing in the way of food products of animal origin, and raise very little for local consumption, since the climatic conditions and the general low standard of living make it possible for whole populations to exist on products of the vegetable kingdom, eked out with fish, and in some cases with game and poultry.

The tropical highlands of temperate climate may now be considered more particularly. These, taken together, are of special interest from the point of view of the world's future meat supplies, since they represent the largest undeveloped regions now remaining in the world, climatically suitable for raising of meat-producing animals. The most important of these in the Northern Hemisphere are the Highlands of Abyssinia, the Highlands of Indo-China, and Southern China, the Southern Mexican plateau and its continuations in Central America, and the Highlands of Columbia, Venezuela and Guiana; in the Southern Hemisphere the most important are

the Highlands of Rhodesia and neighbouring South Central Africa, the Highlands of Queensland and of the Northern Territory in Australia, and the extensive Brazilian Highlands.

Several causes have hitherto hindered the development of animal industries in these regions. The prime cause lies, perhaps, in the fact that there has been a fairly abundant supply till recently from the temperate zones; but there have been other causes, among which are, first, remoteness of these regions from the world's highways and markets; second, their frequent inaccessibility owing to intervening forest-covered lowlands, often unhealthy for Europeans; third, the difficulties in the way of railway construction owing to the mountainous and broken physical structure; fourth, the occupation of some of them, as, for example, in Central and in South America, by indolent and unenterprising peoples; and fifth, and not least, the curse of animal diseases and pests such as cattle tick, cattle fever, tsetse fly, and others that in one form or another, have hitherto played such havoc with the European stock introduced, which in any case degenerates in these regions. To evolve by judicious crosses, disease-resisting, and at the same time profitable breeds of stock, suitable to the conditions of these different localities, is a task that remains still much in the future. Into the possibilities of each of these regions above mentioned, it will be necessary to enter in more detail at a later stage. For the present it is sufficient to note that few of them as yet have any surplus of animal foodstuffs for export, and that, taken altogether, the total production of such foodstuffs in them scarcely exceeds the consumption. So that the meat-consuming and producing world gets at present little assistance from them.

There thus remains only such countries as are within the North and South temperate belts, and upon these the world has to rely for its supplies of meat and dairy produce. In them the productive land is largely already occupied, though considerable areas are not yet producing as much as they are capable of doing, and certainly will do, under more intensive methods of cultivation and animal husbandry. How far the progress of intensive farming will tend to favour animal raising in particular, rather than other forms of production, is a question to which an answer will be attempted later. The conditions at present, however, are such that the industries of meat-production and dairying and of poultry rearing are carried on for all practical purposes, with the notable exception of China, exclusively within the temperate regions inhabited by white men. The labour involved must therefore be done by white men, whose standard of living, especially in the newer countries in North and South America, South Africa, and Australasia, is a high one. Serious competition from tropical countries where cheap coloured labour can be employed is out of the question, and there is no likelihood of such labour being imported for this purpose into the producing countries. It is unfortunate also, in respect of animal-food supplies, that the bounty of nature in the tropics cannot at

present be utilised extensively, since only a very small part of the feedstuffs consumed by domestic animals in the temperate regions comes from them.

Not only are wages high in all the newer countries, but they tend to rise with social progress. Since also these countries contribute an ever-increasing proportion of the world's supply of animal products, and their share becomes more indispensable, the rate of wages paid in them tends to reflect itself in the world-prices for these products. In the older, more densely-populated countries of Europe there is a distinct tendency for the wages of agricultural workers to rise in sympathy with factory wages, but not to the same extent as in the newer countries, owing largely to a much lower value of output per worker in the former. If meat-production and dairying could be conducted on the more modern intensive lines with little human labour, the results might be different. Although in dairying the separator has done much and the milking-machine promises to do more in the direction of lightening labour, it is true that, without considerable human skill and care and labour, the high-grade food products of animal origin now in demand throughout the world, cannot be supplied.

The sources of production may now be considered by groups with some detail as regards special articles. In this connection animal feedstuffs have also to be included. Though the prime consideration is production, the destinations of the special products for consumption purposes require to be noted in discussing world-trade.

At the outset it may be stated as approximately true that the 250 odd millions of people of Western Europe,¹ are unable to obtain a sufficient supply, in keeping with their standards of life, of either cereals or animal products from the land upon which they live. During the last thirty years the centre of cereal production in Europe has slowly migrated eastwards,² pointing to a growing insufficiency in Western Europe, while animal-food products have been brought by sea to the ports of the same western half in ever-increasing quantities during the same period. In respect of this insufficiency of home production, especially in animal-food products,³ Great Britain, as is well known, is in a more extreme position

¹ For the purposes of this discussion Western Europe includes everything west of the meridian of 18° E. long., *i.e.*, those countries with a predominant industrial organisation where also the climatic conditions are influenced by the Atlantic. Eastern Europe (to be referred to frequently later) includes therefore Russia with Poland, the Balkan region, Hungary, and the province of East Prussia in Germany. In these countries the climatic conditions are essentially continental except in the south-western half of the Balkan Peninsula, where they are Mediterranean.

² U.S. Dept. Agric., Bureau of Statistics, *Bulletin* 68, p. 14.

³ The value of animal-food products imported into the United Kingdom is greater than that of cereals. In 1913 (U.K. Statistical Abstract) the value of the total imports of the former was approximately £100 millions, while that of the latter was only approximately 85 millions, but this figure includes items for animal feedstuffs with a probable total value of not less than 30

than any other country. Even countries such as Denmark and Holland, that apparently have a large surplus of meat and dairy products for export, are themselves importers of lower-grade meat and dairy products, and to a remarkable extent of animal feedstuffs and fertilisers, and of cereals and vegetable oils for direct or indirect human consumption. It is these imports that make the exports of higher-grade animal-food specialities possible. Thus in the year 1912¹ the Danish imports of agricultural produce (live animals other than horses, animal food products, cereals, and feedstuffs) were valued at £12½ millions, while the exports of the same were 25 millions; for Holland, in the same year, the imports of the same kinds of agricultural produce were valued at £54 millions and exports at 38 millions. The net imports of wheat and rye, in 1912, into Denmark, had a value of 2½ millions, and those of the same into Holland a value of 11·3 millions. From this it is logical to infer that both these countries import food cereals (which they cannot grow so cheaply themselves) in order to set free more of their agricultural resources for the production of meat and dairy produce, for which they are in several ways singularly adapted. The same observation holds with perhaps even greater force of the great quantities of animal feedstuffs in the form of oats, barley, maize, linseed, oilcake and meals which these countries import in excess of exports of the same articles.

In point of fact, these latter are the "raw material" out of which the people of Denmark and Holland manufacture their high-grade meat and dairy products, just as imports of iron ore and pig iron by the Clyde district, for example, are used to supplement local supplies and reappear finally as finished ships, etc., in the export trade. A further remarkable feature in the foreign trade of both Denmark and Holland appears in the fact that they import lower-grade animal foodstuffs, *e.g.*, American bacon, Siberian butter, etc., partly for home consumption, to replace high-grade goods of the same kinds exported.² Since these countries have organised themselves especially so as to produce high-grade animal foodstuffs

millions, which ought, strictly speaking, to be transferred to the former total. Owing partly to the absence of this correction, it appears, however, that the value of the home production of animal food products bears a higher ratio to that of imports of the same than does the value of the home-grown cereals to that of corresponding imports.

¹ British Statistical Abstract for Foreign Countries, 1914. Only the principal articles are given. The imports of fertilisers into Denmark are not given. Some of the Dutch merchandise is transit goods, free of duty, appearing in both import and export figures.

² The imports of animal foodstuffs into Denmark in 1912 were as follows (expressed by values in £ mill.):—Live animals other than horses, ·07; butter, ·28; lard and fats, ·48; meat, including bacon and hams, ·17; Total, £1·0 mill. Obviously the total exports require to be reduced by these amounts in order to arrive at the true surplus. Some of these items may not be used entirely in home consumption; the live animals may in part be fattened and re-exported later, and the butter may be used to certain extent for blending purposes.

for export from home-grown and imported materials, they (and others like them) may be called the elaborating-commercial group.

The adjustment between the world's production of animal foodstuffs and its consumption of the same is geographically far from simple. The final result resembles a balance-sheet of accounts where the correct equalisation of the totals has been obtained only by numerous transfers from one side to the other of the ledger. In the end, of course, total world's production is equal to total world's consumption plus wastage. It is convenient to follow the ordinary political divisions according to countries, since the statistics both of production and of international trade are classified in this way. It is necessary, also, in order to obtain a clear understanding of the ultimate sources of supplies, to distinguish animal feedstuffs from finished animal food products in import and export trade. This is not so necessary in considering that part of the finished products that enters directly into the home consumption of the newer important surplus-producing countries, such as Argentina, since these countries seldom import animal feedstuffs. The total *consumption* of the great animal foodstuffs importing countries, such as Great Britain, falls into three divisions, namely, first, home production of finished animal foodstuffs, containing as supplementary raw material, second, imported animal feedstuffs, less what is fed to horses or is otherwise diverted from the consumption of food-producing animals, and third, imports of finished animal foodstuffs. Similarly also the total *production* of the surplus-producing and exporting countries may also be divided into three groups namely, home consumption of finished animal foodstuffs, exports of finished animal foodstuffs, and exports of animal feedstuffs. It has been shown above, however, that the separation of animal feedstuffs from cereal foodstuffs for direct human consumption, can be made only approximately in practice.

The most conspicuous feature in the world's balance sheet of the production and consumption of animal food products is the transfer to Western Europe as defined above, from the rest of the world, of such surplus of these products as arises directly, or indirectly through the elaborating-commercial group in the same region. British South Africa, though relatively a small consumer, may perhaps be grouped with the countries of Western Europe, as taking some small share of the surplus.¹

¹ Though it seems necessary, for the purpose of convenience in terminology and statistics, to follow the ordinary division according to countries, this is opposed to any logical regional classification. Thus in British South Africa the industrialised Transvaal accounts for most of the imports of foodstuffs, while other parts, notably Natal, may have at times a surplus in excess of local requirements. Marked industrial, and therefore food-importing areas occur in countries that are mainly food-exporting. Prominent among these areas are the North-Eastern States of America, North-Western Italy, and North-Eastern Ireland. Mining districts, especially in newer countries, represent importing "islands." Conversely, certain parts of highly industrialised countries are predominantly animal-food producing. See below, p. 27

From the standpoint of the production of animal food products or the raw materials for the same, the countries of the world fall into four groups, to which the following names, according to predominant characteristics, may be given :—

- Group I. Surplus-producing.
- Group II. Tropical.
- Group III. Elaborating-Commercial.
- Group IV. Deficient Industrial.

The first group comprises the great temperate new lands of relatively sparse population, namely, temperate North America, including habitable Canada, the United States and Northern Mexico ; temperate South America including Argentina, Uruguay, Paraguay and Southern Chile ; temperate Australasia, including New Zealand and the greater part of Australia ; and Western Siberia. To this group Eastern Europe including Russia, Hungary and the Northern Balkan States must also be assigned. These, with the exception of Eastern Europe, have a surplus of animal produce—meat or dairy products—for export, and none of them import such produce or animal feedstuffs to any considerable extent. The countries of Eastern Europe make extensive exports of animal feedstuffs (oats, barley, maize, oil-seeds, oil-cake, etc.) ; so also in one or more forms do Canada, United States, Argentina and Western Siberia. All of these, and Australia as well (in years of good harvest), also have a considerable export surplus of cereals for human consumption. To the countries in this group, China should be added : though only of minor importance in supplying animal food products such as eggs, lard, pork and poultry, this country is especially noteworthy for exports of certain oil-seeds, namely, soya beans (from Manchuria), ground-nuts and sesame seeds.

The second group includes the tropical highlands already mentioned, and also the lowland tropical areas. Some of the tropical highlands already have a small surplus of meat for export.¹ Such for example are Brazil, Venezuela, Southern Rhodesia, and Northern Australia, but their combined output is insignificant in comparison with that of the rest of the world. The supplies of oleaginous seeds from various tropical regions are of much greater importance, since these seeds yield both oils, that already act as a commercial substitute for butter in the forms of margarine, and also oil-cakes and meals, in addition to commercial oils used in manufacture. Under this head stand, first, copra from many tropical islands and coastal districts, especially in the Indian and Pacific Oceans ; second, palm kernels and other oil-bearing seeds from West Africa, and third, cotton-seed, linseed and ground-nuts from India and Indo-China.

¹ See also above, pp. 21 and 22. The facts are here recapitulated with some additions so as to complete the account at this stage. The present and possible future contributions from the two sections of this interesting group are discussed in fuller detail below, Chap. v.

The third group, here termed elaborating-commercial, has already been discussed in some detail as regards typical countries such as Denmark and Holland. There are, however, various other countries or sections of countries in Western Europe that belong to the same group, the most prominent being Switzerland, Ireland, Coastal Finland,¹ Southern Sweden (Scania), and North-Western France (Normandy and Brittany). Certain parts of Great Britain, Belgium and Germany that specialise in cattle-raising or dairying (generally also with pig-raising in addition), have the same economic structure. These lie to the west in both countries, the clearest cases in Great Britain being the Western Midlands and Somerset and Devon; in Germany the best example is the region covered by Schleswig-Holstein, Oldenburg, Hanover and Northern Westphalia.

Each of the countries in this third group draws part of its animal feed material from countries in the first group described above.

The fourth, or deficient industrial group, includes all industrial countries and regions which, while often engaged also partly in producing animal foodstuffs, have nothing except minor specialities for export, and can in no case fully supply their own needs in such produce. The outstanding countries in this group are Great Britain and Germany, but the industrial areas of North-Eastern France, Eastern Belgium, Northern Austria and Bohemia, and the Southern New England States of America should also be added, as also the mining region of British South Africa, mentioned above. These draw in normal times upon the exportable surplus of animal foodstuffs and animal feedstuffs from the first three groups.

The adjustment between these different groups may be shown in a summarised form as follows :—

PRODUCERS	ARTICLES	DISTRIBUTION (CONSUMERS)
Group I. Surplus-producing (Temperate North and South America, Temperate Australasia Western Siberia, Eastern Europe, Temperate China)	(i) Meats, animal fats, dairy produce. (ii) Feedstuffs (iii) (Cereals) (iv) Oil-seeds.	(a) Group I. (Own home consumption). (b) Group III. Animal feedstuffs, Lower grade animal foodstuffs (cereals) (c) Group IV, Meats and dairy produce, animal feedstuffs, cereals, oil-seeds.

¹ Included previously with Russia in Eastern Europe, but the oceanic climate of the coastal districts brings them regionally into Western Europe.

PRODUCERS	ARTICLES	DISTRIBUTION (CONSUMERS)
Group II. Tropical. (a) Highlands (b) Lowlands	(a) Meat (small (b) Oil-seeds.	(a) Group IV. Meat. (b) Groups III. and IV. Oil-seeds
Group III. Elaborating-Commercial (Denmark, Holland, Scania, Switzerland, Ireland, N.W. France, etc.)	High-grade dairy and meat products	(a) Group III. (Own home consumption) (b) Group IV. High-grade dairy and meat products.
Group IV. Deficient Industrial (Great Britain, Germany, and predominant industrial and mining regions).	Some animal produce for home consumption.	Group IV. (Own home consumption)
	Total production of all articles.	Total consumption plus small wastage.

The importance of the countries in Group I. is further shown by the fact that countries in Group III. supplying Group IV., draw upon the former for animal feedstuffs. It follows that some part of the exports from Group III. *e.g.* from Denmark to Group IV. *e.g.* to Great Britain, represents indirect exports from Group I. countries, *e.g.* Argentina.

In respect of animal produce and feedstuffs the conditions in tropical countries are of the simplest, but in the other three groups the conditions are more complex, and summaries of the "balance sheets" under this head are now given for a typical country in each group.

In the schematic diagrams below the left-hand side in each case represents the various incomings, while the right hand side represents the various outgoings; the totals of both sides are theoretically equal.

The items for Group I, countries may be arranged as follows :—

1. Total production of animal foodstuffs. ¹	1. Total exports of animal foodstuffs and live animals.
2. Surplus production (net exports) of feedstuffs	2. Net exports of feedstuffs.
3. Imports of animal foodstuffs and live meat animals	3. Home consumption of animal foodstuffs.

The items for Group III. countries show a somewhat different arrangement :—

1. Total production of animal foodstuffs, ¹ containing net imports of feedstuffs.	1. Exports of animal foodstuffs and live animals.
2. Imports of animal foodstuffs for home consumption	2. Home consumption of animal foodstuffs.

The items for Group IV. countries show a similar arrangement to these for Group III. countries, but the imports of animal foodstuffs bear a much higher proportion to the total production among the former than among the latter on an average, and the exports of animal foodstuffs are insignificant, so that home consumption absorbs practically the whole of the incomings from all sources in Group IV. countries. The items thus appear as follows :—

1. Total production of animal foodstuffs, containing net imports of feedstuffs.	1. Exports of animal foodstuffs and live animals.
2. Imports of animal foodstuffs for home consumption	2. Home consumption of animal foodstuffs.

Except in the case of Great Britain, imports of animal foodstuffs from foreign sources form but a small proportion of the total consumption. Hence the foreign trade in these commodities is little indication of the actual relations between production and consumption throughout the world.² The density of the population in relation to productive area in temperate countries determines chiefly to what extent the individual country shows a deficit or a surplus in animal foodstuffs; but other factors, such as special climatic conditions and the proportions of the productive area devoted to field crops for export, also enter. Of the typical countries the United States with a moderate net surplus of animal foodstuffs, but a large area under field crops, has approximately $3\frac{1}{3}$ hectares of productive area per head of the population.³ Denmark which imports feedstuffs heavily and makes comparatively large exports of finished animal produce, approx. $1\frac{1}{3}$, and Great Britain, which imports finished animal produce in great quantities to supplement home production in addition to correspondingly large quantities

¹ This would, of course, include live animals sold out of the country.

² It has been estimated that only about 1/13th of the world's meat production, for example, enters into international trade. See Note, page 1, above.

³ Using the figures given in the *Annuaire Statistique Agricole*, 1915, International Agric. Institute.

of feedstuffs as raw material, has less than $\frac{1}{2}$ hectare of productive area per head of the population. Argentina and New Zealand, both of which export great quantities of animal foodstuffs in proportion to their total production, have corresponding high ratios of productive area to population; the latter over 19 hectares and the former over 28—the highest in the world.

As a rule, there is a tendency to attach undue importance to the movements of exports and imports in considering supplies of animal foodstuffs. It is to be noted that the changes in the relations between production and consumption in the larger countries that may perhaps enter little into international trade in these products, have enormous weight. Thus, to take a single instance, the production of butter in the United States is about 26 times that of New Zealand, but the latter country looms large in the world's international trade in butter while the former is insignificant. Yet in proper study of the question, the changes in the relation between production and consumption in the United States are of much more far-reaching importance than those in the exportable surplus from New Zealand.

This caution being borne in mind, it is convenient to take certain selected food articles of animal origin and consider the international trade in them with reference to the groups of countries above described. As regards exported surplus, butter is supplied mainly by countries in Groups I. and III. and the same applies to cheese.¹ Specialisation is a marked feature in dairy products, and, with the exceptions of Holland and New Zealand, no single country is a great exporter of both butter and cheese at the present time. Beef and mutton are supplied almost entirely by countries in Group I. and here again specialisation is apt to arise, Argentina and Australia being the only countries that export both beef and mutton in considerable quantities.² With regard to live sheep and cattle the countries in Group I. have now practically discontinued exports to Europe owing to their distance from the consuming markets and to other causes,³ but there are considerable exports of live meat animals, especially of cattle, from the countries of Group III. in Western Europe. A peculiar feature of the trade in

¹ In butter, the most important exporting countries are Denmark, Russia (with Siberia), Holland, France, Sweden, Australia, New Zealand, and Ireland; in cheese, Canada, New Zealand, Holland and Switzerland.

² In beef and mutton the chief surplus-producing countries are Argentina, Australia, New Zealand, and Uruguay, in beef alone the United States, Canada, Denmark, Mexico and Ireland (exports of live cattle from the four latter being reckoned as beef).

³ The total exports of live animals in international trade were as follows :— (exports of nine principal countries only, and excluding France, Algeria, Ireland and others) :—

	CATTLE	SHEEP	PIGS.
1895	1.1 mill.	1.5 mill.	} average ca. 100,000
1912 .....	.8 „	.7 „	

The decline in overseas shipments of live animals is shown clearly by the change in the imports of the United Kingdom, which, with the exception of

live animals is the movement of cattle (partly immature animals) between the Group I. countries of North America, mainly from Canada and Mexico to the United States. The export trade in pig-meat is highly specialised, only four countries taking any marked share in it; two of these, namely, Canada and the United States, are in Group I., and two, Ireland and Denmark, in Group III. Animal fats and oils (lard, oleo, tallow) form an important article of international trade¹; they are exported almost entirely by Group I. countries, and here the United States is a more important source of surplus supplies than all other countries together. In considering the extent to which individual countries depend upon outside sources for their supplies of animal fats and oils, special attention is required in the case of certain countries such as Holland and Sweden, which use imported animal fats either as raw material in the manufacture of margarine, part of which is exported, or for local consumption, such as a substitute for butter, the exports of which are thereby increased. Eggs are supplied mainly by countries in Group I., but partly also by countries in Group III. Some surplus supplies are derived also from two special districts, namely Northern France and Northern Italy, that tend to have a Group III. structure. Russia, together with Siberia and Austria-Hungary, are much the most important sources of eggs in international commerce.²

The world's exports of animal feedstuffs are made almost entirely, in the first instance, by countries in Group I. but growing quantities are now derived in the form of tropical oil-seeds from countries in Group II. Animal foodstuffs are imported entirely by countries in Groups III. and IV., the countries in the latter group accounting for the larger share.

the French imports of sheep from Algeria, receives most of them.

	CATTLE	SHEEP	PIGS.
1901	495,635	383,594	—
1912	48,912	15,430	—

The import trade in live cattle into the United Kingdom has declined partly owing to a smaller exportable surplus from the United States and partly owing to the embargoes. When the latter were removed, South America had displaced North America as the chief source of surplus cattle, and in the meantime with the establishment of freezing works there, it had become cheaper to export the animals as dead chilled meat. The same change appeared also in the diminished North American trade with the growth of the local market for hides and other by-products.

¹ The exports of animal fats and oils from the nine chief surplus countries in 1912 reached a total of 1158 million lbs., or over half a million tons. The total exports of meat in the same year from these countries amounted to 2·703 million lbs. so that fats and oils constituted rather less than one-third of the exports of meat and meat products.—U.S. Dept. Agric., Bureau of Crop Estimates, Rept., 109.

Attention has been drawn above (p. 19) to the desirability of making some distinction between edible animal fats and oils and those that are ordinarily used as raw materials in manufacture.

² Others of less importance are Italy, Denmark, and Ireland.

As regards the consumption of animal foodstuffs in relation to home production, the various countries and regions of white population can be broadly divided into three groups ; first the surplus-producing regions together with the elaborating-commercial countries ; second, the deficiency countries, which are, as a rule, prominently industrial ; and third, a comparatively small group in which the net surplus or deficiency of these foodstuffs is normally so small as to be negligible. These divisions, however, are not clearly marked, and cross-classification immediately appears when the various kinds of animal foodstuffs are considered separately. Some countries which show a deficiency in one kind are found to have a surplus in another, and this becomes still more striking when the movements of feedstuffs are taken as an equivalent to movements of animal foodstuffs.¹ Thus Denmark and other elaborating-commercial countries show a surplus of animal foodstuffs but are deficient in feedstuffs.² With reference to special kinds of animal foodstuffs, Switzerland, for example, is a deficiency country in butter, meat and meat animals, but a surplus country in cheese ; Sweden is deficient in pig-meat, but has a surplus of beef cattle ; a number of countries, such as Holland, which have a surplus of meat, are deficient in oils and fats ; and in some recent years the United States has shown a deficiency in beef with a constant surplus in pig-meat and oils and fats, and similarly Canada has shown a deficiency in butter with a constant surplus in cheese. We have seen that it frequently happens also within the elaborating-commercial group of countries that lower grade animal feedstuffs of special kinds are imported partly for home consumption, while the higher grade local products of the same or of a similar class are exported. This peculiarity is met with outside the elaborating-commercial group. Indeed almost all countries, even those whose deficiency is most marked, export certain specialities in the matter of animal foodstuffs that are not produced elsewhere, and that find, as it were, a world-wide market among the wealthy or among those who have a special taste for such products.³

The chief importing countries are Great Britain and Germany—in all kinds of animal foodstuffs ; and in addition, in fats and

¹ See table, p. 34, below. Though the method is open to criticism it seems best to take the money values of imports and exports to determine the net balance of animal foodstuffs and feedstuffs in separate countries. This method is sufficiently accurate for the purpose of a general estimate.

² When the movements of feedstuffs are considered in conjunction with those of animal foodstuffs, it is found that the classification of countries into surplus and deficiency areas is not seriously affected. In general, a surplus, or a deficiency of animal foodstuffs, is accompanied by a surplus or a deficiency of feedstuffs, though the elaborating-commercial countries form an exception ; but even in them the total net imports of feedstuffs are in only one case greater by values than total net exports of animal foodstuffs.

³ Examples are sufficiently numerous ; Germany exports sausages and hams ; France, Italy and Switzerland special kinds of cheeses ; Belgium, special kinds of rabbits, and Norway condensed milk. The countries mentioned are otherwise deficient in one or more kinds of animal foodstuffs.

oils, Holland, Denmark, Russia, Italy, Sweden and others ; in meat of one kind or another, Belgium, France, Italy, Cuba, Norway, Sweden, Denmark, Switzerland and even the United States ; in cheese the United States. Only the more important countries have been mentioned. Among the rest, some are more or less self-contained in the matter of animal foodstuffs ; in this class, Portugal, Greece, and the Northern Republics of South America, are perhaps the best instances of countries populated wholly or mainly by white people. In some countries, among which France, Norway and Chile may be mentioned, the value of the total imports of animal foodstuffs is more or less equal to the value of the total exports of the same articles. Since 1913, two countries which were previously among the minor deficiency countries and exported only negligible quantities of animal foodstuffs, have not only reduced their imports to small proportions, but have developed an export trade in meat ; these are South Africa and Brazil. An examination of the above lists of countries having a surplus or a deficiency in the different kinds of animal foodstuffs, shows that some countries appear in both the surplus-producing and the deficiency lists. When however, the balance of imports and exports is taken by values, it is found that of these the following countries have a definite net surplus, namely, the United States, Russia (with Siberia), Sweden, Denmark, Holland and Italy.

When, further, the net imports or exports of animal feedstuffs are considered in conjunction with those of animal foodstuffs, the following results are observed : the surplus position of the United States, Argentina, Uruguay, Canada, and Russia with Siberia becomes intensified, while the deficiency position of Great Britain, Germany and Belgium becomes similarly more marked ; at the same time the surplus position of Denmark, Holland, Sweden and Ireland—countries belonging to the elaborating-commercial group,—suffers reduction. The table below shows in a summary form the international trade in animal foodstuffs in respect of the more important countries by groups, with special reference to animal foodstuffs and to feedstuffs. The absolute surplus or deficiency position by values is thus obtained. In converting the values of imports or exports of cereals or feedstuffs into the values of the contained feedstuffs for food-producing animals, the following co-efficients have been used ¹ ; for feed-cakes and meals, and milling offals, unity ; for oil seeds and nuts $\frac{1}{2}$; for beans and maize $\frac{4}{5}$; for wheat and rye $\frac{1}{4}$; for barley $\frac{1}{2}$; for oats $\frac{1}{10}$. The figures in the table are mostly the average of those for the years 1911-12 given in the British Statistical Abstract and converted to millions of pounds. Some additions have been made where necessary from other sources.

¹ See Part I., Chap. xi.

				Animal Food- stuffs. Total net exports or imports (-) in million £	Feedstuffs Total net exports or imports (-) in million £	Absolute Surplus or Deficiency (-) in million £
GROUP I.						
	United States	...	...	34.36	12.62	46.98
	Canada	...	...	6.63	3.86	10.49
	Argentina	...	...	13.1	23.19	36.29
	Uruguay	...	...	1.2	.08	1.28
	Australia	...	...	10.18	2.26	12.44
	New Zealand	...	...	7.62	.15	7.77
	Russia and Siberia	...	...	35.83	31.8	67.6
	China (1911 only)	...	...	1.56	5.0	6.53
GROUP III.						
	Denmark	...	...	21.93	— 6.59	15.34
	Holland	...	...	5.64	— 8.93 ¹	— 3.29
	Sweden	...	...	3.12	— .47	2.65
	Ireland	...	...	23.52	— 5.01	18.51
GROUP IV.						
	Great Britain	...	...	— 144.84	— 32.04	— 176.88
	France	...	...	— 3.77	— .58	— 4.35
	Belgium	...	...	— 2.9	— 13.6 ¹	— 16.5
	Germany	...	...	— 39.5	— 55.0	— 94.5
	South Africa...	...	...	— 1.25	.27	— .98
	Switzerland	...	...	1.63	— 1.97 ¹	— .34

¹ In these cases, where the different kinds of grain are not specified in the import or export trade either in part or entirely, special conversion coefficients have been taken according to circumstances.

CHAPTER III.

PRODUCTION IN RELATION TO POPULATION AND CONSUMPTION.

SO far as animal foodstuffs are concerned, the consuming population of the world lies almost entirely in three of the above-mentioned groups,—the surplus-producing (group I.) the elaborating-commercial (group III.), and the deficient-industrial (group IV.). The only important exception is the coastal district of Brazil, where the population contains a considerable white element. Otherwise, outside these groups there is an enormous coloured population living largely on vegetable food and raising few food-producing animals. It is the white man who has populated the temperate region of the world with the exception of Eastern Asia ; and he has everywhere carried with him a standard of dietary and a taste for flesh derived from his pastoral ancestors and from many centuries of existence in meat-producing Europe. In this standard of dietary animal produce forms an essential part of the food consumed.¹ Further, wherever Europeans have

¹ It is interesting to note numerous historical instances showing connection between meat-consumption and racial vigour. Since the days of Columbus the meat-consuming Europeans have not only explored, but also colonised or subjugated practically the whole surface of the habitable globe with the exception of Eastern Asia. The Greeks and Romans, in the earlier stages of their expansion, were pastoralists as well as agriculturists, and consumed, doubtless, considerable quantities of meat. Their decline, as also that of earlier civilisations, may not be unconnected with the fact that population overtook pastoral industries (see Chap. ii., above p. 8). The consequent necessity of relying more exclusively upon cereals for subsistence, in the absence of any extensive meat importations, may well have been an unfavourable condition. The comparatively greater vigour of the invading German tribes from the North may be also connected with their greater normal supplies of animal food products.

The stagnation of Asiatic populations is probably due largely to climate, but not entirely so, as shown in China, where large populations have continuously lived in the colder Northern Provinces. The recent remarkable activity of the fish-eating Japanese is also a case in point, since fish supplies the place of animal food.

The physical and intellectual vigour of the ancient Hebrews may perhaps be attributed in part to liberal supplies of meat and milk from their widespread pastoral industries, and it is noteworthy that the more vigorous colonies of modern Jews are considerable consumers of meat and other animal foodstuffs.

While there is no scientific proof for the above suggested theory, it seems to be further sustained by a comparison of nations as they exist at the present day. The Germans consume more meat than the Russians, the English more than the Germans, and the Americans and the British Colonials more than the English, and these peoples are in ascending order as regards nervous vigour and driving force. The Japanese are a notable exception but, as above noted, they consume large quantities of food of high protein ratio in the form of fish.

settled permanently, as in North and South America and Australasia, there has, owing partly to abundant supplies, been a marked increase in the per capita consumption of meat and dairy produce, as compared with ordinary European standards. Thus in recent years the annual per capita meat consumption was about 250 lbs. in Australia,¹ about 200 lbs. in the United States,² about 120 lbs. in the United Kingdom,³ about 110 lbs. in Germany,⁴ 80 in France,⁵ 50 in Russia.⁵

Now the white population of the world in 1901 was approximately 512 millions; in 1911 it had advanced to approximately 588 millions, or an increase of about 15 per cent.

The numbers of food animals are shown in the following table⁶ (numbers in millions).

			About 1901	About 1911
Cattle	...	...	336	344
Sheep	...	...	588	600
Pigs	...	...	141	161

These numbers may be reduced to a common denominator by using a suitable conversion formula. That suggested by R. H. Hooker in the *Statistical Journal*, 1909 and based upon an examination of statistics collected in the United Kingdom over a period of 10 years may be used; where 1 "cattle" = 5.8 sheep = 8 pigs enumerated, in estimating meat production per annum.⁷ On converting the above totals of sheep and pigs into "cattle units" the totals are 614 million "cattle units" for 1901, and 649 million "cattle units" for 1911, and dividing these by the white consuming population in each case, the final results are 1.1 "cattle units" per head in 1911 against 1.2 in 1901, shewing a decline of 0.1 units per head.

¹ *Statistical Journal*, 1904.

² U.S. Dept. Agric., *Farmers' Bulletin*, No. 575, 1914.

³ *Statistical Journal*, 1904 and 1909.

⁴ See p. 130, Note 2 below.

⁵ U.S. Dept. Agric., Rept. 109, pp. 132-3.

⁶ The figures for 1901 are taken from *Bulletin* 55, Bureau of Statistics U.S. Dept. of Agric., and those for 1911 from the U.S. *Yearbook of Agriculture*, 1914. The figures for India are omitted throughout. The enumerations for separate countries were either those of the years 1901 and 1911 respectively, or of years nearest to these dates.

⁷ For the purpose of comparison it is useful to note the corresponding ratios for the United States in the years 1900 and 1910. The average result is that in annual meat production 1 "cattle" = 11.8 sheep = .96 pigs. This would show that cattle are rather more productive as compared with pigs, and considerably more so compared with sheep in the United States than in the United Kingdom. However, the proportions both of beef stock to dairy cattle and of wool sheep to mutton sheep, are higher in the United States than in the United Kingdom and a number of other countries, and these facts sufficiently account for the difference. When Hooker's ratio for the United Kingdom is applied to countries where the composition of any class of live stock is peculiar, some reservations are necessary. Argentina, for example, will have an unusually high ratio of production for cattle, because dairy cattle are relatively few, and Australia similarly a very low one for sheep because merinos preponderate.

According to the estimate above quoted each "cattle unit" in the United Kingdom yields 1·171 cwt. of meat per annum, but the average for the world's meat producing animals is certainly lower than this. The world over, the meat production per "cattle unit" per annum is probably less than 100 lbs. This figure would mean that the meat consumption of the world's white population amounts to about 110 lbs. per capita per annum, but that is more than the estimate based upon the total meat production.¹

It thus appears that there has been a decline in the ratio of food-producing animals to consuming population since 1901. Evidence from various sources goes to show that the maximum relative supplies were available in the period 1890-1900 in modern times. From 1880 to 1890 meat-producing animals in the world increased faster than the (consuming) population²; since 1900 they have increased at a much slower rate than that population.³ Prior to 1881 (which marks the introduction of refrigeration), Europe, which contained the chief meat-consuming population was largely limited to its own resources as we have seen above. In all the history of Europe except perhaps for isolated districts during short intervals of time in the Middle Ages, there never was a period of such abundance of animal foodstuffs throughout Western Europe as during the years 1890-1900. That decade was a time of cheap surplus meat and dairy produce and of cheap surplus animal feed-stuffs. North America was developed but not filled. Since 1900, and more especially since 1906, the Southern Hemisphere has to some extent stepped in to fill the gap caused by the rapidly declining surplus from North America; but its meat-producing capacities are slower of expansion, so that the time of abundance is gone for the present.

That there has been a decline in food-producing animals and in the output of animal foodstuffs, relative to population, since 1900 is borne out by an abundance of local evidence. The British imports of meat declined $1\frac{1}{2}$ lbs. per head of the population in the period 1901-1911.⁴ The per capita consumption of meat in both the United Kingdom and Germany shows a decline in the period 1906-1913. In the 10 years 1900-1911 in a large part of Europe cattle declined per 100 of the population from 34 to 33, sheep from 49 to 42, pigs from 13 to 12⁴; that is, food animals declined from 58·6 "cattle units" per 100 of the population in 1901 to

¹ See below, Part II., Chap. ii., p. 205. This may be explained by the fact that a number of the animals in Asia, Africa and tropical South America are not available for the meat supplies of the white population (see below, p. 41, Note 2). When these animals are excluded the decline in the cattle units per head of the white population between 1901 and 1911 becomes more marked.

² H. R. Hooker, "Meat Supply of the United Kingdom," *Statistical Journal*, 1909, p. 316.

³ R. H. Hooker, "Meat Supply of the United Kingdom," *Statistical Journal*, 1909, p. 316.

⁴ (Cd. 7013), Report on Foreign and Colonial Agricultural Statistics for 1912, Part IV., p. 279.

55.2 in 1911.¹ In the United States the per capita production of meat, including edible offal, declined from 245.5 lbs. in 1900 to 169 lbs. in 1914, while meat exports declined from 32 lbs. per head in 1900 to 8.7 lbs. in 1913.² During the 4 years 1910-1914 meat animals declined by 7 million head, but it is significant that at the same time the total value of these animals rose by 395.5 millions of dollars.²

In Canada, Australia and New Zealand, taken together, the most important animal foodstuffs producing countries within the British Empire, the percentage increase in food animals in the period 1901-11 was only just equal to the per cent. increase in population,³ when allowance is made for the unusually small numbers of sheep in Australia in 1901 owing to the drought. The International Congress of Refrigeration held in Chicago in 1913 came to the conclusion that a shortage of meat in the world trade was undoubted and that the only remedy lies in considerable improvements in the methods of production.⁴

Prices also of meat products, which may be taken as reflecting the abundance or scarcity of supplies in relation to consumption, declined in the United Kingdom with small fluctuations from 1883 to a minimum in 1898.⁵ Since the year 1900 they have shown a general upward tendency. By 1912 the price-level of 1883 was once more reached. The period 1894-1899 marks the lowest part of the curve. It is perhaps not unreasonable to attribute the general low price-level of all other commodities during this period in part at any rate, to the abundance and consequent cheapness of foodstuffs, particularly of animal produce. Cheap production of all commodities depends to a considerable extent upon cheap human labour and services, and these in their turn upon cheap food supplies.⁶

The prime cause of the relative growing shortage of meat supplies since 1900 with the consequent rise in meat prices, has been "the

¹ The corresponding decline for the whole of Europe was from 56.7 to 55.3 units. (See table, p. 41, below).

² U.S. Dept. Agric., *Farmers' Bulletin*, 575, Feb., 1914, p. 3.

³ On taking cattle and sheep only and disregarding pigs (which are of importance only in Canada) it is found that the actual increase, when reduced to "cattle units," is 29%.

⁴ See Weddel & Co., *Review of the Frozen Meat Trade*, 1913, p. 6.

⁵ R. H. Hooker, "Course of Meat Prices at Home and Abroad," *Statistical Journal*, 1912.

⁶ The causes of the general changes in price-levels, and particularly of the rise since 1895, are a vexed question, upon which opinions differ. A number of leading economists in Europe and America hold that the increased gold-supply is the chief determining factor in the recent rise. There is much evidence in support of this theory. For further discussion relative to food prices see :—

Bauer & Fisher, International Agric. Inst., *Bulletin of Social and Economic Intelligence*, April, 1912, Review Article.

I. Fisher, *American Economic Review*, Sept., 1912.

M. O. Zella, *Revue des Deux Mondes*, Oct. 15th, 1911.

Levasseur, *Revue Economique Internationale*, May, 1909.

failure of producing areas to keep pace with the demand." No considerable areas, with the possible exception of Siberia, have been opened up to the world since 1900 in such a way as to throw enormous surplus supplies of animal produce upon the international market, as happened in the two preceding decades. Areas already developed have therefore been severely taxed to meet the increased demand. Moreover, the newer prairie countries of the American type whose vast surplus supplies, especially of animal products, were rapidly made accessible to the world after about 1880, were unfortunately in too many cases cropped and stocked without regard to the future. In point of fact, these countries themselves, and the food-importing countries that drew supplies from them, were living during the last 20 years of the 19th century, partly upon stocks of accumulated capital in the form of the humus deposits of the prairie lands. These deposits were the result of ages of accumulation, and once exhausted, their fertility could not easily or quickly be restored. The most obvious form of soil exhaustion was by successive crops of grain for sale off the farm; but food animals account for an important part of the American consumption of grain, since cattle and pigs have always been "finished" on maize and other cereals in the "Middle West." At the same time, the over-stocking of the ranges further west, where the cattle were reared till sold for fattening, was notorious down to about 1900.¹ It follows therefore, that exports of animal produce and of animal feedstuffs to Europe were indirectly responsible for some share in this deliberate soil exhaustion. Similar methods have also been followed, though perhaps not to the same extent, in the prairie plains of Canada and of Argentina.

The ideal conditions for the production of large quantities of cheap meat are apparently an abundance of fertile land covered with rich natural grasses, together with a convenient and cheap supply of fattening material (cereals, oil cakes, alfalfa), and a fairly sparse population inhabiting that land. The advance of population, which has come so rapidly in North America and moderately so in South America, has caused the disappearance of the best and most accessible land from the pastoral areas, as

¹ *American Economic Review*, June, 1913, p. 448. Review of volume entitled "Proceedings of the Second Annual Conference of the Bankers' Committee on Agricultural Development and Education." Extract quoted: "We are exhausting the elements of soil fertility by operations more akin to mining than to conservative agriculture." Compare also the following resolution passed by a meeting of Texas cattle owners on free ranges many years ago, as characteristic of the spirit prevalent in America a generation ago: "That none of us know, or care to know, anything about grasses, native or otherwise, outside of the fact that for the present there are lots of them, the best on record, and we are getting the most out of them while they last."

U S. Dept. Agric., *Farmers' Bulletin*, No. 72, p. 13.

farm fences swallowed ever more of them within their permanent enclosures.¹

For the present therefore, and until some of the developments in the direction of more intensive methods of production are brought into effect and bear fruit, the world is faced with a shortage in its meat supplies.² Great Britain has perhaps felt this shortage least among important countries, because established connections have given her people the choice of the world's surplus produce; but in other countries, notably the United States, Germany, Austria and France the question has become serious and has attracted much attention.³ Continental countries showed signs of modifying the barriers against the importation of chilled and frozen meat, before the outbreak of the European War, and the United States in the same spirit abolished the tariff of $1\frac{1}{2}$ cents per lb. on all kinds of imported meat in 1913.⁴

In forecasting the probable relations of consumption to production in the near future in different areas, three main tendencies have to be considered; first, of the changes in the ratios of food-producing animals to the population; second, of the general changes in the forms of agriculture in existence, especially with regard to the distribution of resources between pastures and crops, and between the various classes of food-producing animals; and third, of developments in the direction of manufacturing industries.⁵ All of these tendencies are discussed under the heads of the separate

¹ "The number of cattle per square mile increases rapidly in a new and fertile region till population has occupied the land at least to the extent of bringing the land under control for cropping and grazing. After such occupation the influences that increase or decrease the number of cattle per square mile are variable. In some circumstances a further increase may be expected, but in ordinary experience a decline is likely to occur." U.S. Dept. Agric., Bureau of Statistics, *Bulletin*, 21, 1903, p. 27.

² International Agric. Inst. of Social Economic Intelligence, April, 1912. Review of paper by Bauer and Fischer: "The Increasing Cost of Living from the International point of view." Extract quoted: "The meat question predominates more and more from the point of view of private consumption in the problem of the increasing cost of living." (p. 199.)

³ Compare Dominions' Commission, Minutes of Evidence taken in London (Cd. 6517), evidence of G. Goodsir, Questions 4232-4240.

⁴ The following quotations, bearing the authority of the United States Department of Agriculture, show how the question of meat supplies has recently been viewed in America: "A study of the statistical situation in other countries does not disclose where we are likely to obtain any large quantity of beef for an extended period. It appears that England alone could take all the foreign beef available for export, to say nothing of the new markets that have already been formed in other countries," *Farmers' Bulletin*, 560, 1913, p. 17.

Again: "An extraordinary combination of circumstances and factors in all countries . . . to cause a rapid increase of production of beef, mutton and pork, or all, is not to be expected, rather a gradual growth and extension, which may or may not equal the rate of increase of the meat-consuming population," Bureau of Crop Estimates Report 109, 1916, p. 19.

⁵ Tendencies in the rate of consumption, though mainly dependent upon the conditions of supply and prices, may also have some force independently of these factors as shown below (Part II., Chaps. ii. and iv.).

countries, but the first calls for a further world-wide survey here. The table below shows the numbers of cattle, sheep and pigs at the beginning and at the end of the first decade of the present century¹ in each of the four great producing and consuming regions of the world² and also the ratios per 100 of the population.

RATIOS OF LIVE-STOCK IN FOUR MAIN TEMPERATE DIVISIONS IN 1901 AND 1911.

	EUROPE.				NORTH AMERICA.			
	1901		1911		1901		1911	
	mill.	per 100	mill.	per 100	mill.	per 100	mill.	per 100
Cattle ...	121.5	30	127.3	28	73.4	85	67.0	64
Sheep ...	170	42	167	37	65.6	76	55.8	53
Pigs ...	63.2	15.6	75.6	16.7	59.4	69	69.2	66
" Cattle								
Units "	56.7		55.3		184		156	

	SOUTH AMERICA. (Argentina, Uruguay, Chile)				AUSTRALASIA.			
	1901		1911		1901		1911	
	mill.	per 100	mill.	per 100	mill.	per 100	mill.	per 100
Cattle	29.5	330	38.8	330	9.9	215	13.85	247
Sheep	98.1	1100	111.6	950	90.0	1950	117.0	2090
Pigs	1.13	13	3.26	28	1.15	2.5	1.46	2.6
" Cattle								
Units"...	535		529		582		640	

A study of this table shows that the ratio of live-stock to population has been falling in Europe and North America, has been nearly stationary in Temperate South America, and has been rising in Australasia. In spite of some possible increase in the yield of meat from the average units of flocks and herds as enumerated, the general result has probably been that there has been some decline in the per capita consumption of meat throughout these regions averaged together¹; on the other hand the per capita consumption of dairy produce and of poultry and eggs appears to have increased slightly.³

The tendency throughout large areas of the temperate regions for crop cultivation to encroach upon natural or seeded pasture lands has already been noted.⁴ From the point of view of supplies

¹ In some cases, where the figures for separate countries were not obtainable for the years 1901 and 1911 exactly, the figures for the years nearest to those dates have been taken.

² In addition to those detailed in the table there were estimated to be about 100 million cattle, 150 million sheep, and 12 million pigs in other parts of the world exclusive of India. For complete totals see p. 36.

³ For some detailed discussion of the rates of consumption, see Part II., Chap. ii.

⁴ See also Part I., Chap. xi.

of animal foodstuffs, it makes all the difference whether the increased area taken for crops is used more particularly for producing food-crops for human consumption, or for producing crops such as maize, barley and roots of which a considerable part, or the whole of the produce, is used as feedstuffs for food animals. The encroachment of food and industrial crops upon lands formerly devoted to the rearing of animals has been, of course, most noticeable in Europe and North America. The fact that the general ratios of food animals to the population declined in both these continents in the period 1901-11 indicates that these animals lost relatively rather than gained by the process. Among the different kinds of animals, pigs and poultry gain as compared with the rest, whether the result of the process is to increase or to diminish the total crop produce (exclusive of grass) available for food animals, because these are reared independently of pastures; and dairy cattle gain at the expense of pure beef cattle, because when pastures are reduced and crop produce replaces grass, the former animals become more profitable. The most marked feature in the recent decline in food animals, is the decline in sheep ratios in all the four regions taken above except Australasia, where the tendency to decline in the period 1901-11 is masked by the consequences of the drought in the former year.

Not only the advance of population in the consuming world, but general economic progress as well, making fresh demands upon the land available, has brought about a relative decline in the output of animal produce. As there have been some differences among producing countries in the mode of these changes, it is now convenient to consider them separately and in greater detail.

CHAPTER IV.

TEMPERATE SURPLUS-PRODUCING REGIONS.

(a) UNITED STATES.

MOST of the surplus-producing countries belonging to Group I, described above, are still in the earlier stages of development. They have not yet reached their maximum output or surplus, though the future increases will probably be smaller and slower than those already made. The United States, however, owing to rapid industrialisation forms a remarkable exception. Except for specialised products, such as pig-meat and animal fats and oils, it tended, prior to 1915, to import rather than to export animal foodstuffs;¹ and there is little likelihood that its output of these foodstuffs will increase in the future to such an extent as to render heavier permanent exports of them possible.² It must always be remembered, nevertheless, that the United States still is, and may well remain for some years to come, an important source of surplus animal feedstuffs, including cotton-seed and its products.

Interest attaches to the United States as being the first, and for many years the most striking example, of a new country with surplus animal produce for export. The period of greatest meat surplus produce was reached in 1898-1902, when the total exports of meat and meat products averaged nearly one million tons (2,209 million lbs.) per annum. This huge export fell to an average of 1,903 million lbs. for the years 1903-06, but this smaller quantity had a greater export value. By 1910 the exports of meat except of pig-meat and of fats and oils had practically ceased ; still the total

¹ The exports of pig-meat and lard from the United States have continued it is true, to be very heavy, and are such as to make the United States much the most important source of surplus supplies of these products, and even to cause that country to retain a very high place among meat-exporting countries, when all kinds of meat are reckoned together. Thus in the years 1910-1914 the United States furnished about one-third of the world's total exports of meat and meat products. Nevertheless, in 1914 the United States were deficient in no less than four important kinds of animal foodstuffs ; in that year there were net imports of beef, mutton, cheese and butter.

² The changes in the per capita production of typical feedstuff crops serve as some indication of the tendencies in progress in the output of animal industries relative to population. Between 1889 and 1914 the per capita production of maize in the United States fell from 33·7 to 27·2 bushels ; of oats, from 12·9 to 11·6 bushels ; of hay, from 1·1 tons to ·7 tons ; while that of barley rose from 1·2 to 2·0 bushels.

The stimulus afforded by high prices and other conditions during the present war has, however, caused a remarkable increase in the American surplus of animal foodstuffs. This appears to be due, in part at least, to economies effected both in production and in consumption, but it is also due to a decline in immigration, to the departure of large numbers of citizens as soldiers to Europe, to some unusually good harvests, and more especially to a practical cessation of the export trade in feedstuffs.

weight of the exports, including meat products (lard, oleo, etc.) amounted in that year to 1,037 million lbs. Whereas in the period 1900-1904 the United States exported 63 per cent. of the total surplus beef supplies from all countries, in 1913 the corresponding fraction was 1.6 per cent. In 1914 the United States imported 185 million lbs. of beef, mainly from South America.

The changes in the United States cattle trade are even more striking, as shown in the following table:—

	Years 1904-06 (average)	Year 1913	Year 1914
Exports ...	581,815 head	24,714 head	18,376 head
Imports ...	24,310 „	421,649 „	868,368 „

In less than ten years, therefore, net *exports* amounting to about 560,000 head annually had not only disappeared, but had been converted into a net *imports* averaging over 600,000 head for the years 1913-14. This means an average downward movement of about 100,000 head per annum. The recent imports consists largely, it is true, of young cattle for grazing, but the earlier exports were mainly finished cattle of relatively high immediate meat-producing capacity.

The changes in the total United States exports of maize, barley, oats, oil-cakes and meals, and oil-seeds (mainly feedstuffs) taken together, from 1881 to 1911 are shown below. The figures are in millions of tons.

1881	1891	1901	1911
·801	2·366	1·945	1·859

Though considerable quantities of these exports are ultimately used otherwise than as feedstuffs for meat-producing animals, they may be taken as having a theoretical meat equivalent. Each pound of concentrated feedstuffs will produce on an average not less than $\frac{1}{1\frac{1}{2}}$ of a pound of dressed meat. If the above totals are converted at this ratio, the results are as follows in terms of meat:—

Year	1881	1891	1901	1911
Thousands of tons of meat	67	197	162	155

It will be observed that these exports apparently reached a maximum in the period 1891-1901, and that although they declined later, they were still considerable in 1911.

A study of the ratios between meat-producing animals and the population shows, as might be anticipated from the above facts, a startling decline since the year 1900. Thus the number of "cattle units" per 100 of the population, which stood at 182 in

1900, fell to 142 in 1910.¹ Cattle, sheep and pigs contributed about equally to the decline. This means that meat-producing animals were so reduced in numbers relative to the population between 1900 and 1910 that they produced about 22 per cent. less meat for each inhabitant in the latter year than in the former. The ratio of dairy cattle to the population, however, altered little between 1900 and 1910, so that the production of meat was in reality still further reduced through the considerable increase in the proportion of dairy cows to other cattle during the period. On the other hand, meat production per animal per annum probably rose in the interval, and this would balance to a limited extent the reduction caused by the increase in milch cows. On the whole, the figures of "cattle units" above may be taken as a fair measure of the actual change in meat production, relative to the population. The fact that the ratio of milch cows has declined very slightly, while there is known to have been a distinct increase in average milk production per cow, explains the feature that there was less change in net import or export trade in dairy products.

The various forms of encroachment upon large surplus supplies of animal produce, while more marked in the United States than in other countries of the same class, are typical of the whole group. In all of them the area of accessible fertile land is limited, and the rapid construction of overland systems of transport soon makes most of it available. This stage has been reached in the United States, and is being quickly reached elsewhere. Much forest covered land remains in the United States, and a still greater proportion of the surface of Canada, New Zealand, Russia and Siberia, consists of such land, but much of this forest country is either too broken or too infertile to be of value as agricultural land. Moreover, the rapid consumption of timber in the United States, as also in the other countries named, has caused a distinct possibility of something approaching a world-wide famine in timber in the near future, and makes it therefore necessary, from a national point of view, to check further extensive deforestation.² The areas still under forest cannot then in most of these surplus-producing countries, and especially in the United States, be relied upon to furnish any large additions to existing agricultural or pastoral lands. In any case, forest land generally requires the lapse of a much longer period of time, and the expenditure of much more capital and labour before being brought into cultivation, than does open prairie land.³

¹ Obtained by using the United States conversion ratios (see p. 36, Note 7, above).

² Careful estimates made by the United States forestry experts indicate that the timber supplies will last possibly fifty years at the present rate of consumption. However, the rate of consumption may easily increase.

³ See Chap. XII., below, p. 176, Note 4.

In the United States deficiency of rainfall sets another limit to the extension of agriculture, in preventing a rapid expansion of meat-producing pastoral industries. The rough grazing lands or "ranges" of the United States have been damaged in many cases by over-stocking,¹ and it is now found that they require careful management by seeding, limitation of stock, and definite periods of rest if their grasses are to be saved from complete destruction.² The climatic conditions throughout the Western pastoral States are such as to make close grazing by stock no longer possible. The successful growing of lucerne or alfalfa as a forage crop, which is the chief refuge of stock-raisers in those parts of North and of South America liable to partial drought, requires a minimum average of 10-inch rainfall. This condition and others of soil and climate necessary for the successful cultivation of lucerne are absent over the greater part of the western area occupied by pastoral ranges.

The limits upon further extension or expansion of stock-raising are thus more or less definitely set for the present by natural conditions as far as the West is concerned.³ It is now convenient to examine the various ways in which the pressure of population and the increase of field crops for home consumption and for export, have caused encroachment upon the resources available for the production of animal foodstuffs throughout the country. Even the Western Mountain States have suffered in this way.⁴ It will be seen that, without the introduction of more intensive methods of farming, the meat-producing capacities of the country have seriously threatened.

In the first place, population has recently increased faster than the area of farm lands has done, as shown in the following table.⁵

¹ "Pasture ranges which formerly supported 3·2 million cattle now carry only 400,000 head; in thirty years the carrying capacity of the range has much decreased." U.S. Dept., *Farmers' Bulletin*, 72, "Cattle Ranges of the South-West, especially Texas," p. 19.

"To say that, on the whole, the annual crop of forage (in the Western States) is 25% less than it was originally, is believed to be conservative," U.S. Dept. Agric. Bureau of Crop Estimates, Report 110, p. 18.

² U.S. Dept. of Agric., *Bulletin*, 34: "Range Improvement by Deferred and Rotation Grazing," also *Bulletin*, 367, 1916: "Carrying Capacity of Grazing Lands in Southern Arizona," also U.S. Dept. Agric., Report No. 110, 1916: "Live Stock Production in Far Western Range States."

³ However probable future developments may modify these restrictions to some small extent. Various important irrigation schemes are now in progress, and the American Department of Agriculture recommends stock-raising on irrigated lands to provide a change from cropping. Similar additions to live-stock may be made through the progress of dry-farming, the introduction of drought-resisting forage plants, etc., but the total increase through these developments cannot be very great at present. See also *American Geog. Review*, Jan., 1916, pp. 48, 49, where a prominent writer emphasises the likelihood of an increase in the future meat production of the Western States.

⁴ See *American Geog. Review*, Oct., 1916, p. 299: The Mountain States "are in an unstable and transition stage of economic development. The value of the crops now exceeds that of the cattle and sheep."

⁵ Figures taken from Report of the 13th Census, Vol. V., p. 67.

	1890-1900	1900-1910
Increase in population ...	20.7%	21%
Increase in area of farm lands ...	34.6%	4.8%

Although the per capita consumption of meat in the United States decreased noticeably after the year 1900, it is still about 50% greater than that of the United Kingdom, which is the highest among European countries. The annual rate of increase in the population, including increments due to immigration, has been (and will probably also be in the future) higher than that of most other meat-consuming countries. An American authority¹ has stated that the United States will probably be able to support a much larger population in the future, in view of its great natural resources; but he adds significantly that, if the present standard of living is not to suffer, the methods of food production will have to be much more intensive and economical, for this increased population to be realised.

Secondly, the introduction of more intensive methods of meat production, now necessary with the decline of the ranges, is difficult and costly. There is a shortage in the United States of fodder crops which are required for the higher grade stock maintained on higher-priced land. The high cost of labour also, due partly to the competition of rapidly expanding manufacturing industries, increases the cost of raising animals under more intensive methods in which labour charges are an important item.² Although there has been a marked rise in the prices of finished animals, there has been a much greater rise in those of maize and other concentrated feedstuffs.³ The proportion of American beef cattle reared in the Western States shows a marked decline during the last 25 years, and it is clear that the methods of beef production in the United States have to be revolutionised.⁴ Even in America, where adaptiveness and resourcefulness are characteristic human qualities, the newer more scientific methods of agricultural production spread

¹ A. P. Brigham, *Geog. Journal*, Oct., 1908, p. 387.

² Compare the conclusion reached by a German investigator: "If the United States ever again becomes a large exporter of meat products, it can only do so at a much higher price, which will not offer competition to other producing countries," M. Augstin, *Die Entwicklung der Landwirtschaft in den Vereinigten Staaten*, 1914, pp. 120, 121.

³ "During the last census period (1900-1910) corn increased in value at the farm 80%, while steers increased in value only a fraction of this amount." U.S. Dept. Agric., *Farmers' Bulletin*, 560, p. 25.

⁴ "The period of exploitation is passing in the United States, and a new era of constructive live-stock farming is at hand."—U.S. Dept. Agric., *Bulletin*. 20, 1913, p. 2. "The raising of beef-cattle on old-time ranges or cheap pastures and on low-priced corn has ceased, and well-informed men perceive that the raising of beef-cattle must be established largely on new foundations," *Farmers' Bulletin*, 575, p. 7.

slowly, owing partly to the slipshod methods bred during the earlier period of abundant land ; and this factor may effectively hinder the progress of animal industries in the United States for some time to come.¹

Thirdly, the area of farm land devoted to the production of wheat is not only very large, but has been increasing at a rapid rate. In the period 1889 to 1909 this increase was at the rate of over half a million acres per annum. Although this rate is not likely to be maintained in the future, the fact above noted is sufficient indication of the demands made upon American farm lands for the production of food, as distinct from fodder crops. Except for milling offals and straw the land taken for wheat crops in any given cereal year, is, of course, withdrawn from any purpose that might lead to the production of animal foodstuffs, and receives no return in the form of fertilising materials, which it has lost to the crop.

Fourthly, the acreage under cotton in the United States has increased at the rate of nearly $\frac{3}{4}$ million acres per annum since 1879.¹ Cotton requires fertile land, and even though upwards of one third of the seed is returned as manure in America, is an exhausting crop.

The product returned in the form of oil-cake to American farmers is small in proportion to the area of land used. Stock-rearing has hitherto been somewhat neglected as a subsidiary industry in the cotton-growing states, but it may be established more widely in them in the future as a means of keeping the balance against the exhaustive one-crop system.

To sum up the situation with reference to animal foodstuffs in the United States, there is at present a notable surplus for export only in pig-meat and animal fats, and the extent of this surplus fluctuates with the crop yields, notably that of maize ; for the near future, while it is possible that stock-rearing may expand as fast, or even faster, than the requirements of the population in animal foodstuffs, there is a distinct likelihood of a further decline in the surplus. Considerable imports have already been made in certain recent years of such articles as live cattle, frozen and chilled meat, cheese, and butter, and the imports of some of these may be resumed

¹ It is fair to add that the high prices obtained during the war for agricultural produce have provided a stimulus to increased production. Since 1914 the numbers of both cattle and pigs in the United States have increased considerably, but see p. 43, Note 2.

² The acreage under cotton in the United States has been as follows:—

(IN MILLIONS OF ACRES.)			
1879	1889	1899	1909
14.48	20.175	24.275	32.043

It will be seen that the increase was most rapid in the latest decade. The magnitude of the American cotton crop is indicated by the fact that for the season 1911-12 the production of cotton seed amounted to 6.36 million tons, of which, however, only 4.74 million tons were crushed, the rest being used presumably as fertiliser.

on a larger scale in the future. Concentrated feedstuffs, which have been an important item in export trade, are likely to be available in smaller quantities in the future, owing to the growing demands made by American stock farmers.

THE SURPLUS-PRODUCING REGIONS.

(b) CANADA.

Meat and dairy products are produced in Canada mainly in two distinct areas, namely, first, the 35,000 square miles of fertile lowlands in the St. Lawrence valley in the provinces of Quebec and Ontario, where mixed farming, with dairying as a prominent feature, is the general rule, and second, in the High Plains district of South-Western Alberta, adjoining the Rocky Mountains, and including the foothills of that chain, where large-scale cattle "ranching" was, and still is, to some extent, the prevailing industry. The former region shows a steady and fairly rapid advance in animal industries, particularly in the production of milk (for town consumption) and of butter, cheese, and bacon pigs.¹ The latter region has shown a decline in ranching under pressure from the westward advance of cereal cultivation.

In recent years, also, mixed farming has gained a foothold in the prairie provinces of Manitoba and Saskatchewan, and dairying has been established in certain districts (in some cases with Government assistance) as a flourishing industry. The result is that these provinces are now less dependent upon Eastern Canada or upon the United States for foodstuffs than was formerly the case. There seems reason for believing that these prairie province will develop considerably in dairying² and in meat production³ in the future.

Canada remains for the present, however, essentially a grain-producing and exporting country. Even the bacon surplus of Eastern Canada is to some extent the result of using Canadian barley and other cereal products, as well as maize imported from the United States, as pig-fattening materials. The production of cereals for sale elsewhere, namely, to the eastern dairying provinces, to the United States, or for export to Europe, is the great pioneer industry in the western prairie provinces. Unlike the United States, Canada does not make large net exports of animal

¹ In the ten-year period, 1901-11 the population of Canada increased 34.13%, while the milk production increased 43.73%.

² "As yet, in the wheatbelt, this tendency (towards dairying) is just beginning to be noticeable; in the end it will prevail, and Canada will be the first dairying country in the world."—Report of Scottish Agricultural Commission to Canada, 1908, p. 140.

See also Dominions Commission, Minutes of Evidence taken in Central and Western Canada (Cd. 8458), pp. 26-8 (Alberta), pp. 83-6 (Manitoba), p. 73 (Saskatchewan).

³ Dominions Commission, Minutes of Evidence taken in London (Cd. 6517), QQ. 4399-4400. Compare also R. H. Hooker, "Meat Supply of the United Kingdom," *Statistical Journal*, June, 1909, p. 350, and Dominions Commission (Cd. 8458), extracts above quoted.

feedstuffs. On the balance exports and imports of these are nearly equal in value, owing to the relatively heavy imports of maize and maize products for the pig-raising industry of the East, which offset the exports of barley, oats and linseed. Non-agricultural population has not increased as rapidly in Canada as in the United States, and a greater proportion of the cereal crops is therefore available for export.¹ Neither have the fertile prairie lands been taken up and cropped to exhaustion so quickly as they were south of the International frontier.² This is owing to several causes, among which the longer winter fallow season, the slower and later development of railway transport and the more conservative traditions of the farming population are perhaps the most important.

In considering the probable future production of animal foodstuffs, the area of agricultural land still remaining undeveloped in Canada is of the greatest direct and indirect importance. It is quite certain that extensive areas of such land are still awaiting settlement. Concerning the extent of these areas various estimates have been made.³

It appears, however, that the periodicity of the rainfall in the semi-arid belt of Alberta and South-Western Saskatchewan is an important factor, which has not as yet been accurately determined. Even when the area suitable for cereals is more or less accurately determined, factors of an uncertain kind may enter so as to modify the proportion of that land devoted to cereal crops. All that can be safely said at present is that the area of improved land will increase considerably in the near future in the Canadian prairie provinces, and that the cultivation of cereals, especially of wheat and oats, will continue for some time to be the leading type of

¹ It should be noted that in recent years the total wheat production of Canada which attracts so much attention on account of the export-surplus has not averaged more than $\frac{1}{3}$ of that of the United States. Moreover, the production of oats in Canada has considerably exceeded, on an average of recent years, the production of wheat.

² The average wheat yield per acre in Canada exceeded that of the United States by about 30% on an average of the years 1905-1914.

³ Professor Mavor, in the Oxford Survey of the British Empire, 1911, Vol. IV., p. 147, 148, gives an estimate of 22.4 million acres as the maximum area of future wheat-producing land, *i.e.*, about twice the average acreage of the years 1910-12. This, however, seems rather conservative, and there would probably be an additional allowance for other cereal crops than wheat.

Cf., Unstead, "Climatic Limits of Wheat Cultivation with Special Reference to North America," *Geog. Journal*, May, 1912, pp. 441, 442: "The total acreage (of wheat) will be very much greater than it is at present, since it may be extended into the colder regions of Canada and into the drier regions both in Canada and in the United States."

The Dominions Commission, in their Fifth Interim Report, state that the total area in Canada, south of the wheat limit line, is 269 million acres, of which about 115 million acres are unoccupied, but much the greater part of this unoccupied area is over 20 miles from a railway line.

"The immense possibilities of wheat production in Canada are foreshadowed when it is remembered that the acreage under crop is but a small fraction of that available, but as yet untouched by the plough," p. 41.

farming industry, but that animal husbandry will grow more important as meat-packing establishments and dairy factories become more thoroughly and widely established.

Canada, as a whole, is far from being an extensive producer on the balance of animal food produce, and the net exports of feed-stuffs, as previously noted, are practically nil.¹ In the year ending March 31st, 1912, the net exports of animal foodstuffs (live food animals, meats, eggs and dairy products) were valued at about 30 million dollars, while there were net imports of feedstuffs amounting in value to about 2 million dollars. The comparatively small net exports of animal produce and feedstuffs taken together, rather more than 5½ million pounds in value, are due to the threefold economic structure of Canada—with an eastern manufacturing district and a western mining one on either side of the more central food-producing areas. Any growth in the populations of either the manufacturing or the mining district will tend naturally to reduce the exportable surplus. The tendency has already been effective, as an examination of the relative proportions of exports to total production at dates separated by an interval will show.

TABLE SHOWING THE TOTAL PRODUCTION AND THE EXPORTS OF CERTAIN ANIMAL FOODSTUFFS OF CANADA IN SELECTED YEARS AND THE PROPORTION OF EXPORTS TO PRODUCTION IN EACH CASE.

Article	1900			1910		
	Total Production	Exports	%	Total Production	Exports	%
Butter (mill. lbs.)	141.4	25.26	17.9	202.9	4.6	2.3
Cheese (mill. lbs.)	221	186	84.2	201.3	181	85
	1901			1911		
	Total Production	Exports	%	Total Production	Exports	%
Eggs mill. dols.	10.3	1.7	16.6	23.5	.025	0.1
Pigs ² (mill. dols.)	16.5	11.8	71.5	27.6	8	29.

It will be seen that there has been a marked decline in the percentage of exports in all items except cheese, which, however, shows a decline in absolute quantity. The above table, however, does not show all, because between 1900 and 1910 there was a marked decrease in the exports of cattle, and a great rise in the imports of eggs and of butter.

¹ That is without reckoning the milling offals obtained from the exported wheat.

² The value of the animals on hand has been taken as approximately equal to that of the total production of pig-meat.

The general conclusion from the above is that the production of animal foodstuffs in Canada has failed to advance as rapidly as the consumption of the increasing population, since the opening years of the present century. This is further borne out by a study of the figures showing the ratio of cattle, sheep and pigs to the population in the years 1891, 1901 and 1914.

TABLE SHOWING THE NUMBERS OF CATTLE, SHEEP AND PIGS, AND ALSO OF "CATTLE UNITS" PER 100 OF THE POPULATION IN CANADA IN VARIOUS YEARS.

	CATTLE	SHEEP	PIGS	"CATTLE UNITS."
1891	85	53	36	139
1901	104	47	44	167
1914	75	25	42	131

It will be seen that the ratio of live-stock, as a whole, to the population (shown in the last column above) declined notably after 1901, and stood in 1914 at a lower level than in 1891.

For a new country Canada has few sheep in proportion to the population, and still fewer in proportion to the area. Sheep-farming is neglected in Canada,¹ and the above figures show a serious relative decline in sheep which is also absolute.² The result has been that in the last few years Canada has imported live sheep and fresh and frozen mutton in considerable quantities.³ As regards cattle, the relative decline since 1901, above shown, has been accentuated as concerns beef-production by the somewhat greater number of milch cows in the later year, though improvements in beef-stock, feeding methods, etc., may possibly compensate for this. Pigs alone show a relative and, of course, a much larger absolute increase since 1891, due partly to the extension of dairying and more particularly to the increase in the production of butter at the expense of that of cheese, as noted below.

The changes in the Canadian dairy industry and trade in dairy produce since the year 1900 require special attention. Although the estimated output of milk increased in the period 1901-14 faster than the population the net surplus of dairy produce for export declined.

The first step in the process was that the exports of butter dwindled away and this was followed by a decline in the exports of cheese, the milk being used more extensively for the manufacture

¹ According to the Report of the Scottish Agricultural Commission, 1908, the decline in sheep farming is due to: (1) The development of dairying; (2) poor fencing; (3) want of knowledge and skill among farmers. The severe climate has also been an unfavourable factor for Canadian sheep-rearing in competition with other countries.

² The number of sheep in Canada declined from over 3 millions in 1871 to about 2 millions in 1915.

³ In the year ended March 31st, 1912, nearly 200,000 sheep and nearly 4 million lbs. of mutton.

of butter, for the extraction of cream and for consumption as whole milk. In the years prior to 1914 Canada, while exporting cheese to the United Kingdom and cream to the United States, had begun to import butter in considerable quantities.¹

It cannot be too clearly borne in mind that since the abolition of the United States' tariff duties on meats, cream and milk, and their reduction on butter and cheese,² the two countries are practically one market for all these products, as railway transport is well developed between them. In fact, there is not much doubt that the reduction in the American tariff was partly aimed at tapping the Canadian surplus, to assist in supplementing the growing shortage in the United States.

It is quite certain that the conditions of supply in the United States will be reflected in Canada, notably if a shortage arises in the former. Now the possibility of a serious shortage in the near future in the United States has already been pointed out above. It is to be expected, therefore, that an increasing proportion of any Canadian surplus of animal foodstuffs will be diverted thither.³ On an average of years during the last decade Canada has not, on the balance, been an important producer of animal food products for overseas export,⁴ and has shown a tendency to reduce such exports in recent years.

However, changes seem to be at work in the animal industries of the country that may cause an increase in the exportable surplus of animal produce. Into these it is necessary to inquire in more detail.

In the first place, the encroachment of cereal crops upon the one-time cattle-ranching lands of Alberta, though still in progress with the assistance of dry-farming and irrigation, seems nearly to have reached its limits, as it has done in the corresponding region in the

¹ In the fiscal year, 1913, Canada imported nearly 8 million lbs. of butter, and exported less than 1 million lbs.

² The American tariff duties in different animal foodstuffs before and after Oct. 4th, 1913, are as follows:—

	OLD SCALE	NEW SCALE
Butter.....	6 cents per lb.	2½ cents per lb.
Cheese.....	6 " "	20% ad. val.
Cream	5 cents per gal.	free
Milk	2 " "	free
Beef and Veal	1½ cents per lb.	free
Mutton and Lamb	1½ " "	free
Pork	1½ " "	free

³ This has already happened in the cattle trade. Till 1912 nearly the whole of the Canadian exports of cattle went to the United Kingdom, but in the years 1914 and 1915, averaged together, over 95% were sent to the United States. See U.S. Daily Commerce Report, Oct. 5th, 1915.

⁴ British imports of Canadian animal produce (cheese and bacon) have been considerable. It will be readily seen, however, that if Canada has imported butter from New Zealand, mutton from Australia, and sheep and maize from the United States while exporting, or in order to export, cheese and bacon to Great Britain, her real importance in animal industries is to be measured by net, rather than by total exports.

United States.¹ Till quite recently, also, the output of cattle from this district suffered reduction owing to the harmful result of previous overstocking ;² but more recent reports show that a change is coming over the cattle-industry of Alberta. In this, intelligent Government assistance, by means of experiment stations, advice and subsidies, has been helpful. The acreage under lucerne has increased rapidly in recent years.³ Waste and inferior grain is now being utilised more than before as feed and fattening material for stock. Live-stock and crop rotations are being introduced with the spread of mixed farming, in the earlier settled districts, and even dairying has sprung up to supply local needs. The outlook appears rather hopeful.

In the second place, there has been a notable rise in the average milk yield of dairy cows in Canada,⁴ as shown by the fact that between 1901 and 1911 milk production is estimated to have increased 43 $\frac{3}{4}$ %, while the number of milk cows increased less than 8%. The upward limit of improvement has not yet been reached, and developments in this direction will undoubtedly have an uplifting effect upon the whole dairy industry, thus indirectly as well as directly increasing milk production.

Thirdly, there are considerable areas of well-watered land as yet undeveloped on the Pacific Slope in British Columbia, which does not now supply its own needs in animal produce.⁵ Though animal industries have declined relatively to the population, there is reason for believing that these will receive more attention in the future as the lumber industry clears the forests and the progress of railway and road construction makes the interior valleys accessible.⁶ The special advantages here for cattle-raising are a moist climate with mild winters, and an abundance of land.⁷ This region

¹ "In the raising of beef cattle Alberta is now rapidly approaching that low ebb of production which has characterised every country that has changed from the ranching to the farming system."—Canadian Sessional Papers, Vol. IX., 1913, p. 332.

² "Overstocking has been common in the cattle ranches, hence there has been a decline in their fertility."—Canadian Sessional Papers, Vol. IX., 1913, p. 334.

³ To about 14,000 acres in 1915 from nothing a few years earlier.—U.S. Daily Commerce Report, July 6th, 1915.

⁴ The milk yield per cow in Ontario (the chief dairy province) increased from 2,800 lbs. in 1900 to over 4,100 lbs. in 1913.—U.S. Daily Commerce Report, Dec. 29th, 1914.

⁵ The value of the whole agricultural production of British Columbia in 1914 was about 30 million dollars, while imports of agricultural produce were valued at about 25 million dollars.—U.S. Daily Commerce Report, July 28th, 1915. With reference to the resources available for cattle-rearing in British Columbia, and the prospects of an increase in that industry there, see Dominions Commission (Cd. 8458), QQ. 173-9.

⁶ "There is no reason, as the province develops, why the cattle industry should not attain very much larger proportions."—Report of Scottish Agricultural Commission, 1908, p. 103.

⁷ "The growth of the live-stock industry has not been so rapid in this province as would seem warranted by the area available, and the increased prices for animal products."—U.S. Consul at Vancouver in Daily Commerce Report, July 31st, 1912, p. 541.

may be regarded as a likely field for the production of animal foodstuffs in such quantities as to allow of a surplus above local requirements in the future. Progress in this direction has hitherto been held in check by inadequate means of internal transport, by concentration on extractive industries (mining, lumbering and salmon fishing) and by the ease and cheapness with which foodstuffs could be brought as return freight from the prairie provinces by rail, or by sea from the United States or distant countries *via* the Pacific ports.

Fourthly, there are definite indications that stock-raising and dairying will in the near future be established on vast areas of the prairie lands as a relief to the prevailing cereal-crop system which, in the longer settled districts has clearly been overdone.¹ The difficulties in stock-raising on a large scale in the prairie provinces have been summarised as follows:² Want of sufficient shelter and water, summer droughts, shortage of skilled labour, lack of capital for the necessary equipment, and lastly, lack of succulent winter feed. The future of animal industries in the prairie, however, lies rather in small-scale production by individual farmers as complementary to cereal cultivation.³ There is no reason why, with increasing financial stability and with well-directed government encouragement, considerable progress should not be made in this way. Even if the prairie provinces do no more than supply their own requirements in animal produce, this alone will be a relief to the somewhat over-taxed resources of the North American Continent.

It is now convenient to consider North America as a whole with reference to the production, consumption and possible surplus of animal foodstuffs. Except in a limited zone extending from Northern Mexico along the Eastern flank of the Central Chains of the Rocky Mountains into South-Western Alberta, and in some parts among these mountains, large-scale cattle ranching has come to an end. It has disappeared in California, and in an extensive belt intermediate between the prairies proper and the High Plains from Texas to Alberta, where it formerly flourished. Similarly also sheep farming is declining. It appears, therefore, that the whole Continent has to rely for its animal foodstuffs more and more upon supplies raised on small and medium-sized farms by

¹ See Dominions Commission, Fifth Interim. Rept. (Cd. 8451), p. 43, where it is stated that the development of live-stock industries in Canada has been slow, owing largely to slipshod and haphazard methods, but "Canada lacks neither the soil nor the climate needed for the speedy development of the live-stock industry in all its forms." Also (Cd. 8458) QQ. 954-969.

² Farming in Canada—Report of Scottish Agricultural Commission, 1908. Other contributing causes appear to be: (a) the speculative holding of land by absentee owners; (b) the shortage of capital and the heavy mortgage indebtedness of many farmers necessitating quick returns by "cash" crops.

³ See Dominions Commission (Cd. 8457), p. 42. "The development of mixed farming in the grain districts and the prospects of the live-stock industries of the Dominion, are matters of growing importance at the moment."

more intensive methods. Owing to the abundant supplies of maize and other feed materials, pigs will continue to furnish large supplies of produce, especially lard and fat bacon, probably in excess of local requirements.

Extensive developments in several directions are likely in the future: first, the further progress of dairying everywhere (except in the arid regions) and especially perhaps in the Western Prairie region and the Southern States; second, an increase in mutton-sheep raising in the eastern half of the United States, and perhaps also in Canada; third, an increase in the production of beef cattle in the Southern United States and in British Columbia; fourth, further utilisation as feed and fattening materials for North American animals of animal feedstuffs, of which there is now a surplus for export.

As affecting the exportable surplus of finished animal food products, the most weighty factor is the growing population and wealth of the United States, and it is doubtful whether increases in production will be more than sufficient during the next two decades to meet the increased demands of the Continent. The United States already draws cattle from Northern Mexico and from Canada, to say nothing of the imports of meat that have been derived from Argentina and Australia. It is probable that North America will continue to furnish for some time to come, supplies of certain specialities such as pig-meat, lard and other animal fats, cheese, and oilcakes and other concentrated feedstuffs, for export to Europe. The experience of the years 1900-14 points to the conclusion that the net surplus of animal foodstuffs from North America may be a declining one in the future, unless European consumers can afford to pay such prices as will make more intensive farming generally possible under North American conditions. In these circumstances, however, the production of all foodstuffs will be stimulated not only in Europe itself, but in the new countries of temperate climate outside North America; for this continent now lacks both the cheap labour of Europe and the extensive per capita land resources of other new regions.

SURPLUS-PRODUCING REGIONS.

(c) ARGENTINA.

Argentina, more than any other country producing surplus animal foodstuffs, lives by export and import trade. Coal, iron and manufacturing industries are all markedly absent. Even Australia and New Zealand, which have the highest per capita foreign trade of all countries, are less dependent upon external sources for supplies of iron and manufactures than is Argentina, and between them they produce coal in excess of their own requirements. Argentina is the extreme type of a specialised pastoral and agricultural country, just as Great Britain is the extreme

type of a specialised industrial one. It follows, therefore, that, as compared with other countries in the same class, the Argentine surplus of animal and cereal produce bears a very high proportion to total output, and is more apparent than elsewhere. Since Argentina has no industrial population to feed and a comparatively small leisured class, much produce goes into export channels that in other countries is consumed by local non-agricultural populations. By way of illustration, the case of the United States may be quoted, where the remarkable decline in the export surplus of animal produce shortly after 1900 was partly due to the growth of manufacturing industries; manufactured goods have there tended to be substituted more and more for foodstuffs in the export trade.

The total production of animal foodstuffs in Argentina cannot be accurately ascertained owing to inadequate official statistics, and the same is more or less true of the numbers of animals, of which only an occasional census is taken. Except as regards exports, therefore, the available statistical material consists largely of estimates only.

The following figures will serve to show the tendencies in production, and in export trade of animal foodstuffs from the Republic :

	1895	1908	1911	1914
Total "Cattle Units" (mill.)	35.3	42.5	46.3	37.7
"Cattle Units," per capita	8.9	6.9	6.5	4.6
	1901	1905	1910	1912
Meat Exports (tons) ¹	171,370	347,003	372,003	510,510

It will be seen that the numbers of Argentine live stock, expressed in "cattle units" passed a maximum prior to the year 1914. It is true that later estimates show an increase upon the figures for 1914, but the previously existing numbers have apparently not yet been completely restored.² On the other hand, there was a continuous and somewhat rapid increase in the quantities of meat exported between 1901 and 1912, and more recent figures show that since 1912 the total exports have been maintained at the same level, if not actually increased.³ This is all the more striking, since the table shows that the per capita numbers of "cattle units", declined continuously and sharply between 1895 and 1914. Several factors have contributed to this discrepancy between the numbers

¹ Including live cattle (average = .720 lbs. dressed meat) and live sheep (average = 55 lbs. dressed meat).

² In 1917 the estimated numbers of cattle and sheep in Argentina were respectively 29 millions and 55 millions—Weddel & Co., Review of the Frozen Meat Trade, 1917. In 1911 there were estimated to be 28.8 million cattle and 80.4 million sheep in the Republic; in 1914, 25.9 and 43.2 millions.

³ The exports of meat (exclusive of live animals) from Argentina in 1915 were estimated at 471,250 tons, which marks an advance upon the figures for 1912.

of live stock and the quantities of meat exported, all of which have significance as bearing upon future tendencies.

First, there is evidence that the per capita consumption of meat in Argentina has fallen in recent years,¹ thus releasing some additional supplies for export trade. As this figure was apparently excessive till recently, a decline in the rate of consumption would quite naturally follow the general rise in prices. Second, there have been considerable importations of British pedigree cattle and sheep which have resulted in enormous improvements in the quality of Argentine live stock. As regards cattle, the indifferent native "cirollo" stock is being rapidly graded up² by means of the imported blood stock, especially Shorthorns, with the result that the returns in meat per animal are quicker and heavier and of better quality. The rapid decline in the exports of salted beef (to about one-third) since the opening years of the century points to the disappearance of the jerked beef industry, which utilises only the poorer grades of cattle. In sheep-breeding the tendency in recent years with the progress of the railways has been to sacrifice wool-producing to mutton-producing qualities.³

The establishment of a number of freezing works at Buenos Aires for dealing with cattle and sheep, and at points further south for dealing with sheep, has given great impetus to improvements in the breeds of meat-producing stock.

Third, the rapid extension of the area under alfalfa or lucerne (from 390,000 hectares in 1888 to nearly 5½ million hectares in 1912) has caused an increase in the meat-yield per animal enumerated. Alfalfa pastures carry about three times the number of stock carried by the same area of good native pastures, and have a greater fattening capacity.⁴ It is probable also that in the near future maize will be used as finishing material,⁵ as this is regarded as

¹ The following figures have been given for the per capita consumption of meat in Buenos Aires city, which contains $\frac{1}{5}$ of the whole population: 1911, 343 lbs.; 1912, 307 lbs.; 1913, 274 lbs.; 1914, 233 lbs.—U.S. Daily Commerce Report, Oct. 4th, 1915.

See also Report of British Consul at Buenos Aires for 1912-13, p. 40, where the Argentine meat consumption is given at 275 lbs. per head for the towns, and more for the country, and where it is stated that wasteful forms of meat consumption are common.

² This is shown clearly by the percentages of different classes of stock in the two census years 1895 and 1908.

	1895	1908
Natives	65.4%	37 %
Grades	22 %	48.4%
Pure breeds .....	.3%	3.2%

From figures given in *Farmers' Bulletin*, 581 (S.U. Dept. Agric.), p. 32.

³ U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin*, 48.

⁴ U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin*, 48, p. 55.

⁵ *Ibid.*, p. 32, also U.S. Daily Commerce Report, Nov. 11th, 1910, p. 566. Unfortunately the maize-growing districts are distant from the great cattle regions and no important "finishing" industry has as yet grown up round the freezing works, as has done round the packing centres in the United States.

essential by expert authorities for the production of first-class meat.

A fourth factor that has contributed to the maintenance of meat exports, while the numbers of meat-producing animals have declined, is that slaughterings have evidently exceeded the normal rate of increase both of cattle and of sheep. This means that the numbers of breeding-stock have suffered unduly in order to feed the export trade¹; part of the exports of meat have been made, as it were, from capital instead of from income. Obviously this process could not continue without ultimately reducing the quantities of meat available for export. It was apparently most obvious in the period 1912-14; since that time the numbers of cattle and sheep have shown a tendency to recover.

Fifth the increase in the numbers of pigs, both absolutely and per capita, shown in the table above, has supplied the local market with additional supplies of meat; and, though pig-meat is not exported in appreciable quantities, has naturally led to an increase in the exportable surplus of beef and of mutton above the figures at which it would otherwise have stood.

Of the five factors above described, the first three and the last will, if continued, have a positive effect in increasing the export surplus; while the fourth, if similarly continued, will lead to a serious curtailment of the surplus, though its immediate result has been to increase it. Reference to Table A, above, shows that there was a general decline in the ratios of "cattle units" to population throughout the whole period 1895 to 1914, but that this decline became very marked between 1911 and 1914. However, in a country such as Argentina, where the ratios of live stock and of productive land to the population are unusually high, this decline is not so serious as it would be in a country where the same ratios are relatively low. The proportion of the total output of meat required for local consumption is small. The changes in the total numbers of food-producing animals and in their productivity per unit are of greater significance in estimating the future tendencies; and, though the numbers of cattle and sheep in Argentina reached a low ebb in 1914, there are reasons for anticipating that the more recent upward movement will continue.²

In spite of a somewhat rapid increase in the population in recent

¹ The British Consul at Buenos Aires in his Report for the year 1912-13 pointed out that the stocks of animals raised in Argentina had not kept pace with the meat exports. "It is clear that the time has come for replenishing the herds by the acquisition of store cattle" (p. 40). See also U.S. Dept. Agric., *Farmers' Bulletin*, 581, where it is stated that in the period 1908-12 the increase in cows slaughtered was 171%, while that for steers was only 62% (p. 34). "The demand for an increase in the Argentine meat output has had the effect of restricting the natural increase of the herds" (p. 40). See also U.S. Dept. Agric., Bureau of Crop Estimates, Report, 109, p. 26.

² See U.S. Dept. Agric., Bureau of Crop Estimates, Report 109, p. 26. "Eventually high prices of cattle, the extensive raising of alfalfa, and ample facilities for slaughtering and exporting will lead, it would seem, to a great expansion of the beef-producing industry in Argentina."

times,¹ the pressure of population upon land resources in Argentina is scarcely yet felt. It will be many years at the present rate of increase before the country is field in the sense that the United States are. There is at present, in fact, a recurring shortage of labour in the agricultural districts that impedes progress. It is quite possible that an increased population, if distributed over the agricultural regions, would make an increased export-surplus of animal produce (and cereals) possible.²

The resources of the country for animal industries are great. Land suitable for settlement is not yet limited in the same way as in the United States, even though the existence of a semi-arid belt running north and south parallel with the Andes and adjoining them, sets a limit to the westward migration of farming and even of grazing under ordinary conditions.³ The area of Argentina is about 730 million acres, of which at least one half is productive. In 1912 there were 57 million acres of agricultural land cultivated (including 15 million acres under alfalfa). There are, therefore, 308 million acres of available agricultural land, of which 75 million acres are said to be suitable for wheat.⁴

With the extension of railways there has been a great increase in cereal cultivation during the last two decades, as shown by the increase in the exports, which for all cereals, including linseed, rose from an average of 1.73 million tons in 1895-7, to that of 4.13 million tons in 1902-4, and to that of 6.06 million tons in 1910-12.

The further extension of all forms of agriculture (including animal industries) in Argentina, depends upon a number of conditions, chief among which is improvements in the means of transport, including railways, roads and port facilities. The present system of large holdings is hostile to progress⁵ and efforts are being made to bring about closer settlement.⁶ The methods of production are often primitive, especially in cereal cultivation.⁷ In the stock-raising industries scarcely any provision is made for sheltering animals, and very little is done in the direction of growing fodder crops to tide over periods of drought. Agriculture suffers from the evils of the tenancy system whereby large landowners let part

¹ The estimated population of Argentina was 4.8 million in 1901 and 7.1 millions in 1911. The increase was therefore nearly 50% for the decade.

² For discussion of the optimum population in new countries for export-surplus, see Chap. x., pp. 153-156. below.

³ The northern parts of the country are tropical in climate and are largely covered with dense forests. Even when developed and cleared this section (about $\frac{1}{4}$ of the whole area) will not be suitable for ordinary animal industries. Its future lies in tropical products (sugar, etc.)

⁴ Report of British Consul-General, Buenos Aires, for 1912-13 (Cd. 7048-60).

⁵ See Report of British Consul at Buenos Aires for the year 1911. See also *Bulletin* of the American Geog. Society, Sept., 1915, p. 680: "The greatest obstacle to Argentine progress is the land question."

⁶ See figures given in the Argentine Year Book, 1914, pp. 244-5.

⁷ See Report of British Consul at Buenos Aires for the year 1907, p. 10.

of their holdings to small cultivators without capital resources, on the share-crop payment system. The result is a lack of interest in the land, which seldom receives any fertilisers and becomes impoverished. In the outlying districts, suitable for stock raising, considerable capital expenditure is required for fencing, for the improvement of pastures, and for the means of controlling animal diseases which are apt to be destructive among both cattle and sheep.

The question arises in this inquiry whether future developments are more likely to favour animal industries than crop-raising. Down to about the year 1900 Argentina was mainly a pastoral country, and pastoral exports greatly exceeded in value those of cereals. Since that time there has been a change, and on an average of recent years agricultural exports have come to exceed the pastoral. In some ways animal-raising industries have suffered. Cattle raising has been concentrated more in the alfalfa provinces (Northern Buenos Aires, Cordoba, Corrientes) and sheep-farming has been driven further south with the progress of wheat cultivation. It will be noted that with the exception of wheat, the cereals grown in Argentina may be classed as animal feedstuffs, and the increased production of these, therefore, favours the production of animal foodstuffs, if not in Argentina, at any rate, in the countries that import these materials. Various authorities are agreed that there is every prospect of great developments in pig-raising for meat-export purposes¹, and this would cause some of the animal feedstuffs, *e.g.*, maize, to be consumed locally instead of being exported. At present, however, the prevailing Argentine fashion of leaving animals too much to take care of themselves is hostile to the development of pig-raising,² and, indeed, except on the large "estancias," to that of sheep and cattle farming on modern lines.

Cereal cultivation has received great impetus, as in North America, from the fact that quick cash returns are possible.³ The progress of stock-raising in Argentina in its present and future developments requires considerable capital outlays. It is said that large areas are still available under pressure for stock raising, "but the grasses are too coarse and unpalatable and must be replaced by short grasses, alfalfa, rye grass, barley and oats"⁴;

¹ R. H. Hooker: "Meat Supply of the United Kingdom," *Statistical Journal*, June, 1909, p. 351.—U.S. Daily Commerce Reports, Nov. 19th, 1910: "Pigs are bound to become more important with the growth of intensive farming." U.S. Dept. of Agric., Bureau Animal Industry, *Bulletin* 48: It is quite safe to predict that some day pork will be one of the chief sources of Argentine wealth."

² See U.S. Daily Commerce Reports, Nov. 19th, 1910.

³ But more with reference to the small tenant than the large land-owner. The river provinces, owing to summer rainfall, are in any case better adapted to alfalfa than to wheat. Elsewhere also, labour is short, and that available is better suited to cattle-raising through character and training than to cereal production.

⁴ Report of British Consul at Buenos Aires for the year 1912-13.

all this requires resources which none but the great cattle-kings of the country possess, and they have no need to move out from their large estates to the more distant parts. Argentina, in fact, has nearly reached the limits of the possibilities under the older large-scale ranching system,¹ and is scarcely ready for the newer more intensive system, for which the newcomers at least lack the necessary capital, skill, patience and technical knowledge. This is especially marked in dairying, which, however, is also hindered by opposition from the breeders of beef-cattle.

In the end, the question of meat-production *versus* cereal cropping is more likely to be decided by the comparative price-levels than by other factors. The present outlook indicates that prices will favour animal industries, though higher prices for animal produce mean also higher prices for animal feedstuffs, the chief item in the competitive cereal crops in Argentina. However, if freights remain high after the European War, exports of the more bulky feedstuffs will be discouraged.

It remains to be said that Argentina is better provided with transport and port facilities for handling meat than grain, but the operations of the powerful meat-packing Trusts in control of a number of the freezing works, require to be considered with a view to their probable future effects. Their profits are known to be large, and there are already indications that they are acting so as to discourage the free and natural increase of production.

SURPLUS-PRODUCING REGIONS.

(d) URUGUAY, PARAGUAY, CHILE, SOUTHERN BRAZIL.

The above-named regions, together with Argentina make up the whole of temperate South America, and it is convenient to discuss them at this stage before proceeding to more important regions. With the exception of Chile, also, they form geographical extensions of Argentina to a large extent, and are inhabited mainly by a similar class of population.

Uruguay is much the most important of these in exports of animal produce. The greater part of this country resembles in climatic conditions and physical features the neighbouring provinces of Argentina across the Uruguay River and the La Plata Estuary. Cereal cultivation, however, is followed to a much smaller extent owing to a less advanced stage of general development. There are great stock-raising industries on both sides of the river boundary, and, while the climate of Uruguay is both milder and moister than is common in Argentina, its soil is suitable in a few places only, for the cultivation of alfalfa,² which is the great cattle fodder crop in the former. In spite of the fact that the native

¹ See U.S. Dept. Agric. Bureau of Crop Estimates, Report 109, pp. 168-171.

² W. H. Koebel, "Uruguay," 1911, p. 247: "Very few districts in the country are adapted to the favourable cultivation of alfalfa."

pastures are rich, the capacity of Uruguay for meat production is for the present, therefore, more or less limited.

The total area is only about 72,000 square miles and live-stock figures show a relatively high density owing to the uniformly sufficient rainfall¹ and the small proportion of the area devoted to cereals.² Uruguay is a specialised pastoral country and has little importance as an exporter of animal feedstuffs. The per capita ratios of cattle and of sheep, both of which have been extraordinarily high, rose somewhat between 1900 and 1908, but by 1916 had declined noticeably.

Pigs, which numbered about 200,000 in 1912, contribute as yet nothing of importance in the export trade. The figures used above for 1916 are taken from Messrs. Weddel & Co.'s Review of the Frozen Meat Trade for 1916. If these are accepted, it is found that since 1908 both cattle and sheep have declined in Uruguay, the latter to less than half. These changes form a striking parallel with the similar changes in Argentina, and may be attributed mainly to the same great cause, namely, overslaughtering consequent on the rise in the prices of stock since 1908.

There has been considerable progress as in Argentina in the quality of live stock, through the introduction of pure-bred animals,³ so that the food-producing value of each unit enumerated has risen. It is not surprising, therefore, when these facts are considered together, to find that there has been a great increase in the exports of meat and meat products. The total of these items, including live animals reduced to terms of dressed meat, rose from 39,000 tons in 1901 to over 78,000 tons in 1911, or more than doubled in ten years.

In recent years in the export trade in cattle products there has been a tendency to substitute frozen and chilled beef for jerked beef, and even for meat extracts, while similarly frozen mutton has tended to displace tallow. The establishment of large freezing works at Monte Video has contributed to these changes.

With regard to the future, the country may be expected to increase its output of meat and perhaps its exports at a moderate rate for some time to come. The population is not large, neither is it increasing rapidly, and it is possible that the per capita meat consumption will decline to some extent. On the other hand, the area is limited, and unless fodder and fattening crops are more extensively cultivated, or are imported, the surplus meat produce available cannot increase much beyond certain definite limits.

¹ U.S. Year Book of Agriculture, 1913, p. 359: "A large part of the country is well watered and naturally suited to stock raising, which is the principal industry."

² The chief cereals cultivated are wheat, maize and linseed, but not much in excess of local requirements. The total net exports of these three articles taken together amounted to about 42,000 tons on an average of the years 1910-12.

³ Koebel, "Uruguay," 1911, pp. 254-264.

In spite of general climatic advantages, droughts occur occasionally, which, under the present system of production, are destructive to live stock. The exports of meat are therefore liable to fluctuations and this feature is likely to be apparent also in the future.

PARAGUAY.

Paraguay is distinctly sub-tropical in climate and rainfall, and resembles the neighbouring northern part of Argentina. It consists of forested ridges, with intervals of open grasslands, and its wealth lies rather in timber and tropical products than in pastoral products. In this respect Paraguay forms a contrast with Uruguay, which is overwhelmingly pastoral, and contains only small forest areas, and these in the more remote parts near the Brazilian frontier. Owing to its tropical climate, its unenterprising inhabitants, its extensive forests, and its great distance from tide-water, Paraguay has remained in a backward state of development, from which there is no immediate prospect of progress.

While some of its forest and tropical products find their way down the Parana to overseas markets, its trade in animal-products is mainly with the neighbouring republic of Brazil, to which it exports jerked beef, while drawing its supplies of young cattle from the interior parts of the same country. Stock-raising industries are at a primitive level. Sheep are few and degenerate, having lost both fat and wool.¹ Cattle are said to number about 5 million head,² but are nowhere near the Argentine standard as meat-producers,³ owing to centuries of neglect and acclimatisation in the tropics.¹ Needless to say, no pure-bred stock exists in the country, and scarcely any attempts have been made to improve the breeds or the pastures, or to combat animal diseases, which are troublesome.⁴ Surplus cattle are suitable only for jerked beef or for the manufacture of extracts,⁵ and there is little likelihood that such surplus will be fit for refrigeration, even if transport is available, for many years to come.

Accurate statistics of the numbers of, and trade in, cattle and

¹ A. K. Macdonald, "Paraguay," 1911, pp. 231-2.

² U.S. Daily Commerce Report, Aug. 2nd, 1912, but a British Consular Report for 1913-14 states (p. 8) that "the total stock of cattle in Paraguay probably does not exceed 3½ million head."

³ Cf. British Cons. Report. for 1913-14, p. 8: How far it will be possible to breed high-class stock with advantage presents a problem that has still to be solved."

⁴ Foot and mouth disease and the blowfly do much damage, while cattle tick is very prevalent except on the Chaco.

⁵ "Only the lowest grade of stock is found in this part of South America. The meat is only fit for extract and canning, or immediate consumption, not for refrigeration."—U.S. Daily Commerce Report, Aug. 2nd, 1912. However, a British Consular Report states that the enhanced prices of cattle are likely to displace the production of jerked beef by more economical methods.

meat products are not obtainable,¹ so that no clear picture of the industry can be found. In spite, however, of certain natural resources in climate and pastures, the net surplus output of animal food produce seems unimportant, and large developments are improbable.

SOUTHERN BRAZIL.

The temperate region of Southern Brazil includes the provinces of Rio Grande, Santa Catharina and Parana, all three of which are naturally adapted to all kinds of stock raising, and have developed rapidly in recent years.² The region covered by these provinces has the advantages of good pastures, highlands suitable for sheep, cheap lands and nearness to the sea for export trade. Cattle are raised throughout, sheep on the Highlands and pigs in Rio Grande.³

The total numbers of these animals are not accurately known,⁴ but there is good reason to believe that they are increasing faster than the population.⁵ The size of the animals is small and the quality poor except perhaps in parts of Rio Grande, where considerable care is taken with breeding.⁶ The surplus meat at present finds its way into the markets of Northern Brazil in the form of jerked meat, but the improvements in cattle-breeds now in progress together with the increasing surplus and the declining market for jerked beef in Northern Brazil, should very shortly make a surplus of refrigerated meat available for overseas export. Down till quite recently Brazil, as a whole, has not been able to meet its own requirements in meat from home production, but there are indications of a considerable future development of animal industries in Eastern and Central Brazil which will relieve the situation there, and even provide an export surplus.

The extent of the possible future surplus of meat products from Southern Brazil is intimately bound up with developments in other parts of the country. Improvements in transport between the inland districts and the coast are badly wanted everywhere, and much depends on these. In other ways the prospects for a surplus of refrigerated meat are distinctly favourable. The Government has actively encouraged the improvement of stock by making

¹ An American Report (No. 109, Bureau of Crop Estimates) gives the exports of meat from Paraguay as follows :—1903, 7 million lbs. ; 1909, 1·4 million pounds ; 1912, 4 million pounds. If these figures are accepted, it will be seen that the exports have not only been very fluctuating, but have shown a downward movement since 1903.

² There are said to be 2 million sheep in Rio Grande alone : " Brazil in 1913."

³ Mainly by the German colonists : " Brasilien," H. Schuler, p. 428. There are said to be 18 lard factories in this province.

⁴ According to the statements of various authorities temperate Southern Brazil must have not less than 10 million food-producing animals of which at least half are cattle.

⁵ Commissao d'Expansao Economica do Brazil, Vol. II., p. 178.

⁶ The production of jerked beef in Rio Grande was 113 million lbs. in 1909 and 141·2 million lbs. in 1913, an increase of 25%.—U.S. Daily Commerce Report, Oct. 5th, 1915.

special arrangements for the importation and distribution of pure-bred animals ; steps are being taken to deal with animal diseases ; and the natural pastures are rich, the rainfall abundant and well distributed, especially in the southern provinces, and large areas are said to be suitable for the cultivation of alfalfa.¹

CHILE.

From the point of view of this inquiry only that part of Chile which has a sufficient rainfall is of special interest. The strip of country lying north of 30° S. is not able to meet its own requirements in animal foodstuffs. This fact will place a positive check upon any great expansion of net meat exports from the country.

The exports of meat from Chile in 1913 amounted to about 8,500 tons, a very small item compared with other countries, and at present there does not seem to be much likelihood of an increase. Stock-raising in Chile does not seem to be keeping pace with the general development of the country.² The land in the more settled parts can apparently be used more profitably for cereals, owing to cheap imports of cattle from Argentina. Sheep are gaining at the expense of cattle³ which are less suited to the southern stock-raising belt. At present no provision is made by way of fodder crops during the dry season, and contagious diseases are common.⁴

The exports of meat are made at present entirely from the territory known as Patagonia or Magallanes, where freezing works have been established. In the future, however, sheep-rearing may develop in the more or less forested belt between 45° and 50° S. with the progress of settlement and the clearing of the forests. On the whole, however, there does not appear to be any likelihood of a great increase in the production of surplus meat in this or in any other part of Chile.

TEMPERATE SOUTH AMERICA.

REVIEW AND SUMMARY.

A general review of the present conditions relating to the production of animal foodstuffs and feedstuffs in temperate South America shows that pastoral industries on the ranching system are still predominant ; that, on the whole, much more attention is given to cattle than to sheep ; and that except in the cold southern peninsula, the latter animals are being displaced by cereal cultivation. The population is in general sparse, and in any case is not of a type that will readily adopt the more laborious and carefully-

¹ Brazil in 1911, Chap. xvlii.—Since the outbreak of the European War an export trade in meat from Brazil has commenced, which has grown rapidly. Thus in 1915 the exports were 8,000 tons ; in 1916, 33,130 tons ; in 1917, 66,450 tons. According to a recent report, further expansion in this trade is to be expected.

² U.S. Daily Commerce Reports, May 6th, 1914.

³ *Ibid.* ⁴ *Ibid.*

planned intensive methods of production ; except for improvements in stock and the extensive cultivation of lucerne, in both of which the large " estancieros " have been foremost, very little progress has been made beyond the simple pastoral system. The dairy industry, therefore, has developed to a quite limited extent, being confined to part of the Argentine province of Buenos Aires ; while feedstuffs such as maize, linseed, oats and bran, produced in the river provinces of Argentina and Uruguay, are mainly exported. Outside a region lying within a radius of about 400 miles from the city of Buenos Aires, stock-rearing industries are still in the initial stages.

In recent years the production of wheat in those parts more accessible to the ports has increased rapidly. This form of agriculture, however, probably represents an intermediate stage between the pastoral system and the more intensive methods of rearing animals. The land is now too valuable for the former, and the present stage of general development is not ripe for the latter. The question of soil fertility will probably make a return to stock-raising necessary in those districts that have been cropped to partial exhaustion. In any case, the competition of cereals is felt at present only in Central Argentina, and may be less serious in the future, because, apart from the above-mentioned factor, the general conditions of soil and climate seem more favourable to stock-raising.

Altogether this geographical region is now the most considerable source in the world of surplus meat, and will remain so. In spite of the recent decline in the numbers of live stock in Argentina and Uruguay, a general advance in the output of meat may be expected under the stimulus of high prices, in the whole area east of a line drawn from Asuncion in Paraguay to Concepcion in Chile. According to all authorities there still remain enormous areas of pastoral land of sufficient rainfall throughout the more remote parts of this region, which are as yet either partly or wholly undeveloped.

In order to reach the full capacity of its output this great region requires, first and foremost, capital for internal development in the form of railways, irrigation works, improvements in live stock and pastures, and farm equipment ; second, greater technical knowledge and more systematic methods on the part of ordinary stock-raisers ; third, some increase in the agricultural population. Each of these conditions may take some time for its fulfilment. However, the prosperity of this region, owing to the high prices of stock during the European War, may lead to a more rapid development than would otherwise have been the case. There is no likelihood of any considerable mining or industrial population springing up in this part of temperate South America in the near future, and this fact, together with a consideration of the general resources and circumstances, makes it appear that this region will furnish a steadily—perhaps rapidly—increasing surplus of meat

and meat products, especially of beef, for many years to come. With regard to dairy produce and pig-meat, although the exports of neither of these from South American countries have been of note in the past, it is possible that at a later stage of development of these countries, the surplus of both will be of importance in international trade. In this event, however, the export trade in concentrated feedstuffs is likely to receive some check.

SURPLUS-PRODUCING REGIONS.

(e) AUSTRALIA (INCLUDING TASMANIA).

The limitations imposed by geographical conditions upon the extension of animal industries are more obvious in Australia than in any other of the important surplus-producing regions classed above in Group I. Less than $\frac{1}{8}$ of the whole continent has an average rainfall of 20 inches or more.¹ If 20 inches annual average rainfall be taken as the minimum for ordinary agriculture, this feature alone imposes severe limitations upon the area available.² But more than a half of this fraction lies within the tropics,³ leaving only about $\frac{1}{9}$ of the whole area in the temperate zone with a rainfall of 20 inches or more. Even this fraction is subject to further deductions, since it includes bare mountainous land in Victoria and New South Wales nearly up to the snow line, as well as scattered tracts of forest country at lower levels, and areas of barren sandstone in the coastal belt of New South Wales. About $\frac{1}{10}$ therefore, of the entire continent, or an area of $2\frac{1}{2}$ times as large as the British Isles is fertile, and has a really sufficient rainfall. It appears, therefore, that the possible progress of animal industries on the intensive system common in Western Europe is small compared with the size of the continent, though greater compared with the numbers of the population.

However, stock raising in Australia has been by no means confined to the temperate area having more than 20 inches rainfall. This industry has always been much more of the "ranching" pastoral type than of the intensive farming type, and being largely concentrated on wool-producing merino sheep, has flourished over large areas with a rainfall between 10 and 20 inches. Indeed, the exclusive pastoral stage was not threatened by more intensive

¹ Commonwealth Year Book, Vol. VII. The areas given are :—

Rainfall 20–30 inches	535,307 sq. miles
„ 30–40 „	212,297 „
„ over 40 „	188,986 „
Total	936-590 „

out of a total area of 2,975,000 sq. miles.

² Much of the Australian wheat, however, is grown in districts where the total rainfall is less than 20 inches, but falls almost entirely during the growing period.

³ "Australia—Physiographic and Economic," 1915, Griffith Taylor, pp. 246–248.

farming to any serious extent till about the close of the 19th century.¹ More intensive methods² have been developed especially in the coastal belts of higher rainfall, these being more suitable in the first instance, and also nearer the large towns, which are the centres both of local consumption and of export trade. In point of fact, this land has been rather neglected by the pastoralist, because not well adapted to wool-sheep.³

It is now generally recognised that land with more than 16 inches rainfall is suited for closer settlement⁴ and that the zone with 12-16 inches rainfall may become so suitable with proper development in the future; but it is left to the grazier for the present, as also is much of that having 16-20 inches rainfall. Between the lines of 10 and 20 inches rainfall there lies an enormous tract of nearly 1 million square miles⁵ in tropical and temperate Australia, which therefore has been, and still largely is, the grazing ground of the 80 to 100 odd million sheep of the country. It is noteworthy, however, that during the last twenty years there has been a general retreat of wool sheep all along the line from the 20 inch isohyet, and that the large squatter is gradually withdrawing behind the 12-inch isohyet.

In considering the progress of Australian stock-raising industries, allowance must be made for the periodical droughts (such, for example, as those in 1899-1902 and in 1912-1916) that cause great downward fluctuations.⁶ It is natural that sheep should be more affected than cattle in view of their distribution with reference to rainfall areas, and that wool-producing sheep should be affected more than mutton sheep for a similar reason. If a drought is general, mutton production will show a decline before wool production does,⁷ especially if the drought commences in the spring,

¹ "The close of the 19th century may be taken to mark a decided change in the character of Australian industries. Broadly speaking, the Commonwealth was then terminating what may be described as its pastoral era."—Oxford Survey of the British Empire, Vol. V., p. 147.

² In the forms of dairying, crop-production, and the rearing of mutton sheep.

³ Oxford Survey, above quoted, Vol. V, pp. 182, 183.

⁴ *Ibid*, pp. 181, 182.

⁵ The Commonwealth Year Book, Vol. VII., p. 64, gives 958,600 sq. miles. approximately.

⁶ The following table for selected years shows the "drought depressions" in sheep and cattle for the Commonwealth:—

	SHEEP million.	CATTLE million.		SHEEP million.	CATTLE million.
1900	70.6	8.6	1914	78.6	11.0
1902	54	7	1916	69.2	9.7
1904	66	7.8	1917	74.2	10.05
1911	93	11.8			
1912	83.2	11.6			

It will be seen that minima were reached in the years 1902 and 1916.

⁷ Exports of mutton are much more immediate than those of wool which is sheared in the last quarter of the year and gradually exported during the twelve months following.

as is often the case, since wool is in the nature of a harvest from winter growth while mutton sheep require fodder for fattening up till the time of slaughter. The decline in mutton production, symptomatic of a drought may, however, be disguised by the fact that a number of unfinished animals are rushed to the freezing works with the first shortage of fodder.

The general movements in the live-stock figures in Australia are shown in the following table for 5-year intervals :—

	SHEEP.		CATTLE.		PIGS.	
	mill.	per cap.	mill.	per cap.	mill.	per cap.
1890.....	97·9	31	10·3	3·3	·89	·28
1895.....	90·7	26	11·8	3·4	·82	·24
1900.....	70·6	19	8·6	2·3	·95	·25
1905.....	74·5	18·5	8·5	2·1	1·01	·25
1910.....	92·0	21	11·7	2·7	1·03	·23
1914.....	78·6	15·9	11·05	2·24	1·01	·17

It will be noticed that there has been no general increase in the numbers of any of these three classes of animals since 1890, with the exception of cattle, and even these have not kept pace with the increase in population as shown by the per capita ratios.

“Considered in relation to population the live stock-attained its maximum in the period 1890-5 and its minimum in the year 1902.”¹ However, other causes than that arising from changes in the per capita ratios of live-stock have been at work. The operation of these causes becomes apparent on comparing the figures in the above table with those of the values of total exports of animal foodstuffs since the year 1900, as shown below :—

TOTAL VALUE IN MILLION POUNDS OF ANIMAL FOODSTUFFS²
EXPORTED FROM THE COMMONWEALTH.

1901	£4·578	1910	£9·1
1905	£5·12	1913	£11·75

Even when the figures for the later years are discounted somewhat according to the rise in prices, it would show that the exports in 1913 were about double of those in 1901, while in the period 1900-14 the total numbers of cattle, sheep and pigs increased by a much smaller ratio, and actually declined in per capita ratio.

The progress of settlement in Australia at the present stage of its development tends to increase not only the total output of all foodstuffs, but also the surplus available for export. Since the first gold-rushes there always has been an important mining population in Australia, and more recently certain industrial and leisured classes have arisen. Any marked increase in one or more of these

¹ Commonwealth Year Book, Vol. VII., p. 275.

² Including live animals, and therefore also horses not intended for human food.

non-agricultural classes reduces the export-surplus. At the present time there is a distinct tendency for industries to expand,¹ with the result that more of the total output is intercepted by the home market. Notwithstanding this, the advancing population lives mainly by producing and exporting pastoral and agricultural products. Though as yet animal foodstuffs form a relatively small proportion of the total agricultural and pastoral products exported, there is a tendency for this proportion to increase,² owing to the changes in progress from purely pastoral, to mixed farming, *i.e.*, from wool production to the production of mutton, dairy produce and wheat.³

Down till quite recently the gain in wheat production has not been so great as that in meat production and dairying, but it is possible in the not distant future that while the latter continue to expand, wheat cultivation will increase much more rapidly.⁴ It will do this not so much at their expense, as by utilising land as a rotation crop in conjunction with more intensive sheep farming and dairying⁵ and still more by utilising land, now half idle as pure pastoral land,⁶ behind the 20-inch isohyet.

Since 1890 the increase in mining population has been comparatively small, the only marked developments having taken place in Western Australia, but the additions to the population of the Western State were largely drawn for some years from those of the Eastern States, so that the actual gain of population to the Commonwealth was but slight.⁷ It should be added that this movement was mainly of a floating mining population unsuited to agriculture. On the other hand, there has been a continuous, though perhaps slow, increase in the population on the land and a

¹ This expansion is assisted by (a) the resources of the Commonwealth in coal, iron and other metals; (b) the distinct desire of the people to encourage local industries and to be independent, as far as possible, of foreign manufactures.

² The proportion of exports of animal foodstuffs to total exports of agricultural and pastoral produce rose from 15.6% in 1901 to 17.6% in 1911 by values.

³ The total area of private lands acquired for closer settlement by the various State Governments amounted to 2 million acres by 1901 and 2.7 million acres by 1912.

⁴ Cf. Dominions Commission, Second Interim Report (Cd. 7210, p. 51) which recommends the bulk handling of wheat as a means of greatly increasing wheat production in Australia, which "has at present considerable areas of land just outside the margin of profitable wheat cultivation."—See also Dominions Commission Minutes of evidence taken in Australia at Adelaide and Perth.

⁵ Especially with irrigation and the cultivation of fodder crops. See U.S. Daily Commerce Reports, Dec. 19th, 1910. See also Dominions Commission Minutes of Evidence in Melbourne, Q. 8130.

⁶ U.S. Daily Commerce Report, Oct. 6th, 1910, p. 65. See also Dominions Commission Minutes of Evidence taken in Sydney, Q. 7654, where a prominent witness stated that the cutting up of large estates has been shown to result in "double the production of wool and mutton even with one half under wheat."

⁷ Commonwealth Year Book, Vol. VII, p. 89.

fairly rapid one in that engaged in preparing and handling the products in towns.¹ The total population of the Commonwealth has increased since 1890 more rapidly than is generally supposed. Between 1890 and 1912 the increase was just over 50%,² very little short of the percentage increase in the United States during the same period. If this rate of increase in Australia is continued during the next two decades, its influence upon the output and surplus of animal foodstuffs will be considerable,³ since Australia is now more or less in the same stage of development (though poorer in agricultural resources) as the United States were about forty years ago. It will be some considerable time before the population in Australia begins to gain on agricultural production as in North America.

As settlement proceeds, capital expenditure, resulting in greatly increased returns, becomes possible. The readiness shown by the Governments to invest capital in reproductive works of importance to agriculture is marked in Australia, and must be of the greatest value in the future. Railways and other means of transport have been probably the greatest factor in the development of Australian animal industries. They have made it possible to raise wheat and mutton on land distant from the seaports, which once produced nothing but wool. Railways are essential for the conveyance of mutton and beef stock from the pasture lands to the port freezing-works, without loss of condition.⁴ With the growth of a more extensive railway system the transport of stock from drought-stricken districts is becoming possible.⁵ Whereas sheep and cattle formerly perished wholesale owing to lack of water, it is now more possible to move them to places where water is more plentiful, or to the ports where they can be converted into meat. Finally, with the growth of the railway system under State control, the carriage of fertilisers and feedstuffs at low rates will make the utilisation of these essentials in increased agricultural production possible in many places where they were formerly out of the question. Though much has been done in advancing railway construction, the vastness of the productive area, together with an average low output per acre, creates problems of an unusual kind in the provision of efficient transport services. Much, therefore, still remains to be done. Owing to considerations of financial stability, the Australian States

¹ In semi-industrial processes such as wool-sorting, slaughtering and refrigerating, and in export trade business.

² From 3.15 millions to 4.73 millions.

³ Opinion in Australia favours the idea that increased agricultural population means an increased surplus of foodstuffs, especially those produced under more intensive conditions, *e.g.*, meat and butter. See Dominions Commission Minutes of Evidence taken in Australia, QQ. 7783, 7909, 8134-8.

⁴ According to evidence given before the Dominions Commission in Sydney, the existing railways are congested and live stock frequently suffer through excessive time taken for transit on the railways. (Cd. 7172, QQ. 7552-7663).

⁵ Australian droughts are frequently partial only.

cannot push forward their railways more rapidly than the increase of settlement warrants. In this and in other directions it is evident that the further development of Australian animal industries still depends largely upon the increase of agricultural population.¹

A second form of capital expenditure required for the further development of animal-rearing industries is upon irrigation works and artesian bores. The former have already been undertaken on a large scale by two of the State Governments; the latter have hitherto been almost entirely the result of private enterprise on the large stock "runs." Though artesian waters are insufficient for irrigation, besides being chemically unsuitable for that purpose, their value in providing live-stock with water in the drier interior districts, especially of Queensland, is very great. They make stock-raising possible where otherwise the vagaries of the rainfall and the insufficiency of surface streams would work destruction with the sheep and cattle that thrive upon the rough natural vegetation. As the best scientific opinion is concentrating on the view that these artesian waters are due to rainfall precipitation,² it may be presumed that the supplies of water can be relied on for the future, though not perhaps in greater quantities in the basins now tapped, than hitherto. Besides the Great Artesian Basin, a number of smaller ones in South Australia and Western Australia, not yet completely surveyed, are known to exist. These will be of the greatest value to pastoralists in large districts where shortage of water is perhaps the only impediment existing to the raising of sheep and even cattle. Since the supply of artesian waters is so vital to stock-rearing interests over large areas of semi-arid Australia, a much greater measure of Government control and enterprise is to be anticipated. The inter-State Government commission, charged with the duty of supervising and controlling the use of artesian waters will probably make the available resources of greater economic value.

The artesian areas, however, are naturally more suitable for merinos than for mutton sheep, though in some cases they support cattle. However, with the general change throughout the world from merinos to crossbreds in response to the demand for mutton, the supplies of wool from these areas in the future will be of indirect moment in the world's supplies of animal foodstuffs by setting sheep lands free for mutton production elsewhere.

The large irrigation works in course of construction and proposed in the valleys of the Murray and of its tributaries, will convert great areas of ordinary pastoral lands into valuable agricultural

¹ Dominions Commission, Minutes of Evidence, Australia (Cd. 7172). Q. 8137: "The agricultural output will increase, not in proportion to the land under cultivation, but in proportion to the people cultivating it."

² Dominions Commission, Second Interim Report (Cd. 7210), also (Cd. 7172) Minutes of Evidence, Australia, QQ. 9320-9789. The theory that the Australian artesian waters are of plutonic origin has been maintained, especially by Gregory.

lands, which it is anticipated will specialise in the production of wheat, fruit, dairy produce and fat lambs. These areas should be able to supply a considerable surplus above local needs for the home market and for export.

Capital expenditure is also required for a number of miscellaneous purposes to further the development of agricultural industries directed to the production of foodstuffs; for roads, harbour construction, port facilities; for clearing and fencing land; and for labour-saving machinery.

It appears now that considerable areas of first-class cattle-raising land exist in several parts of Northern Australia, notably in the Kimberley District and in the Highlands of the Northern Territory,¹ and that large areas in the interior of Western Australia, formerly regarded as permanent desert, are suitable for sheep.² It appears also that there is no lack of fertility in Australian soils, so that the present and future problems are connected more with water supplies than with the preservation of soil fertility.

After full allowance has been made for the general deficient rainfall, the periodical droughts, the floods in the north, and the vast extent of desert and semi-arid country, it yet remains true that Australia has far from reached its full development in animal industries. It is still in the main a new country, but one that has special problems to face. To increase its exports of animal foodstuffs materially, it still requires population and capital and scientific adaptation to its special difficulties. Its fluctuating exports of meat and dairy produce might be regularised to some extent by means of fodder crops, and its low average milk yield per cow³ be increased in the same way. At the present time too much reliance is placed upon the native grasses which, though they are said to possess excellent milk-producing and fattening properties,⁴ are naturally apt to run short or fail at times.

Australia occupies an intermediate position among exporting countries with regard to each of the three important classes of animal foodstuffs in which it has specialised, namely, mutton and lamb, beef, and butter.⁵ In the first of these it is second after New

¹ For a detailed account and reference to authorities, see Chap. V., below p. 106.

² J. W. Gregory: "Geographical Factors that control the Development of Australia."—*Journal Royal Geog. Society*, June, 1910, p. 664.

³ The average yield of Australian cows in 1911 was estimated at 280 gallons as compared with about 630 gallons for Danish cows.

⁴ "There is evidently great room for improvement in the average herd" (of dairy cows).—British Association for the Advancement of Science. Handbook for Australia, 1914, p. 397.

⁵ U.S. Daily Commerce Report, Dec. 1st, 1910.

⁵ The average exports of these products from Australia for the years 1908-12 were as follows:—

Beef (refrigerated)	94.5 million lbs
Mutton and lamb (refrigerated)	128.7 "
Butter.....	72.7 "

The exports of other animal foodstuffs, as also of feedstuffs, are unimportant.

Zealand; in beef exports it was next to Argentina in the years 1910-14, but the surplus was but a fraction of that of the South American Republic; in butter, taking an average of years, it has occupied about the fourth place, its exports amounting, however, to rather more than one-third of those of Denmark and less than half of those of Siberia in the years preceding the outbreak of the war.

It is not likely that the rate of development of animal industries, except, perhaps, of dairying, will be rapid in Australia in the future. In the most prominent branch of these industries, namely, sheep-rearing, the production of wool is still of much greater importance than that of mutton¹; though more attention is being given to the latter than was formerly the case, progress in the substitution of crossbreds for merinos will be gradual owing to geographical, climatic and labour conditions.² The tendencies of the moment favour perhaps an increase in the production of wheat rather than in that of meat, which may follow at a later stage. Even the production of wheat in Australia, like that of wool, so long as it utilises land without encroaching upon the resources available for the production of meat and milk, assists the world-situation in the matter of these products, by relieving the pressure upon land for cereals in other countries. While some witnesses before the Dominions Commission in Australia expressed optimistic views concerning the near future, the conclusions reached by the Commission are more or less restrained in tone.³ This report is based on evidence taken some time ago; in the meantime there have been drought conditions in Australia, and, although production has been stimulated by war prices, labour difficulties have increased owing to the cessation of immigration and the withdrawal of men into the army.

SURPLUS-PRODUCING REGIONS.

(f) NEW ZEALAND.

Not only relatively to its area, but also absolutely, New Zealand stands among the world's more important exporters of surplus animal foodstuffs. This is due to a small population, a highly favourable climate, natural fertility, and a marked

¹ See U.S. Dept. Agric., *Bulletin*, 313, 1915.—“Over 70% of the sheep in Australia to-day are of Merino breed. Of the crossbreds that make up a large part of the balance, most are from Merino ewes” (p. 9).

Also British Association for the advancement of Science—Handbook for Australia, 1914, p. 394.—“The difficulty is that the Australian cannot help regarding the sheep as primarily a wool-producer.”

² U.S. Dept. Agric. Year Book, 1914, p. 337.—Australasia “can and doubtless will increase its production (of wool and mutton) to a considerable extent. Such an increase cannot be a sudden one. With the high cost of labour, the advance towards any system requiring an increase of labour is likely to be gradual.”

³ See Dominions Commission, Final Report (Cd. 8,462), pars 105-122.

accessibility of all parts of the country to the coastal ports. These conditions have led to an extreme specialisation in animal industries. In this respect New Zealand resembles Denmark with the difference that it does not require to import animal feedstuffs. The cultivation of cereals (wheat and oats), formerly an important branch of agriculture in the South Island, has declined relatively. The country now, on an average of years, barely produces enough wheat for its own requirements, and has a fluctuating surplus of oats for export. The most marked feature in New Zealand agriculture is the high proportion of the area under sown grasses,¹ as compared with other countries, and this is naturally a great source of strength in animal-rearing industries.

New Zealand contains 66 million acres of which in 1913, 40 million acres were occupied and 25 million acres untouched.² Of the latter 10 million acres are useless, consisting of barren, mountainous country and infertile wastes. The remaining 15 million acres are largely covered with forest, which must be cleared before they can be utilised for animal-rearing. However, some allowance must be made for the preservation of standing forests or for re-forestation for timber supplies in response to the needs of advancing population.³ It appears, therefore, that the greater part of the available agricultural and grazing land is already occupied in New Zealand, and future developments in animal industries are to be expected in the more intensive utilisation of land already occupied.⁴

Like Australia, New Zealand ranks low among countries exporting a surplus of animal feedstuffs. The only important items in this class are pulses and oats ; but the latter, as noted in Chap. i., above, are not used except in small quantities as a feedstuff for meat or milk-producing animals, and the New Zealand exports of this cereal, moreover, have been very fluctuating.

The most marked features observed in a study of New Zealand exports of animal produce since 1890 is the rapid rise in the values of frozen meat, and still more of dairy produce as compared with those of other exports.

¹ At the beginning of the year 1911 there were 14·2 million acres under sown grasses, which was more than a third of the occupied land, and much greater than the area under sown grasses in the whole of Australia and Tasmania.—New Zealand Official Year Book, 1913, p. 562.

² Dominions Commission, Minutes of Evidence, New Zealand (Cd. 7170, p. 166).

³ A more detailed discussion of the competition upon land made by the demand for timber appears in Chap. xi., below. Grazing is clearly more affected than crop production, especially in New Zealand.

⁴ As in Australia, the subdivision of the large sheep runs in the more fertile districts is regarded as an essential step in this direction. The native pastures have lost productivity owing to fires, rabbits, and overstocking, and measures such as those that have been adopted in the United States require to be taken, in order to restore them.

TABLE SHOWING VALUES OF VARIOUS CLASSES OF NEW ZEALAND EXPORTS, 1892-1915.

	1892	1902	1912	1915
	£ MILL.	£ MILL.	£ MILL.	£ MILL.
Frozen meat	1.033	2.718	3.9	7.8
Butter ;	.318	1.369	3.769	5.4
Cheese				
Total Animal Foodstuffs	1.351	4.087	7.669	13.2
Wool	4.3	3.354	7.1	10.4
Gold .....	.952	1.951	1.345	1.7

In the 20 years, 1892-1912, the exports of animal foodstuffs rose from 15% to 36% of the total exports by values, and their combined value was more than five times as great in 1912 as in 1892. This should be compared with the increase in the value of wool exports during the same period. It will be seen that the 1912 figure was less than twice that of 1892. Hence the exports of animal foodstuffs have increased nearly three times as fast as wool exports, which shows clearly that the country has changed its animal industries from a predominant extensive to a predominant intensive pastoral form. The value of the wool exported in 1892 was over three times that of the animal foodstuffs, while in 1912 it was actually smaller than the latter.

The detailed figures of exports (not given above) show that while during the period 1902-12 butter and cheese exports together increased more rapidly than meat exports, the increase in them is due more to cheese than to butter, the exports of cheese by weight having increased no less than nearly eight times in the ten years.¹

All the facts above noted are explained by the present stage in the progress of New Zealand agriculture. During the 20 years 1891-1911, the area of cultivated land (including land under sown grasses) rose more rapidly per inhabitant than the area of holdings. The country is now reaping the benefit of pioneer work in forest-clearing of an earlier decade. It has been shown that the remaining areas of unoccupied land are now small, and, though considerable areas of "stump" land may yet come into cultivation, limits to the expansion in the area of productive land are in sight. The refrigerator and the separator, together with an advanced system of

¹ The exports of cheese from New Zealand have continued to expand rapidly since 1912, and promise to do so further in the future. See Report of H.M. Trade Commissioner for New Zealand, 1916, p. 10.

agricultural co-operation¹ have done much to enable New Zealand producers to take advantage of their resources. With regard to the future, it is hardly likely that the present rate of progress can be continued indefinitely, though several witnesses before the Dominions Commission in New Zealand expressed optimistic views on this matter.² The further adoption of machinery, especially of the milking-machine, may add to the productive capacity of the country, but in the main further developments depend upon improvements in transport and the wider use of more intensive methods. In the last resort it is a question of population, which has not yet reached the optimum for surplus exports.³

The population of New Zealand has roughly doubled since 1890. In spite of this fairly rapid proportionate increase in population there were about 40 acres of occupied land per inhabitant in 1911 as compared with less than $1\frac{1}{4}$ acres per inhabitant in Great Britain, where the severer climate is less favourable to animal industries.⁴ Further, the demands made upon land in New Zealand for other purposes than for the maintenance of food-producing animals are small. The ratio of these, therefore, to the population is very high. The table below shows the ratios per 100 of the population and the changes in these ratios at intervals since 1891.

	1891	1901	1911	1916
Cattle	133	160	197	205
Sheep	2,900	2,460	2,340	2,128
Pigs	49·4	32	34	25
" Cattle Units "	695	624	643	603

It will be noticed that there has been a general slight decline in the combined ratio of these animals to the population since 1891. But the study of the movements of exports has brought out two facts:—first, a general change from wool sheep to mutton and lamb breeds, and second, a much greater proportion of dairy cows among cattle. It will be noticed, further, that the ratio of cattle to the population shows an upward movement owing to the advance of dairying, while that of sheep has steadily but slowly declined. However, the turnover from the sheep flocks has increased owing to the above-mentioned cause as well as to marked improvements in meat-producing breeds and methods of feeding and fattening.

¹ Dominions Commission, Minutes of Evidence, New Zealand (Cd. 7170, Q. 2630.—"The whole dairy industry in New Zealand is associated in a system of co-operation." There is also extensive co-operation in the meat industries as shown by evidence given before the Commission.

² *Ibid.*, Evidence of J. A. Johnstone, G. R. Marshall, Albert Kaye, and others.

³ For a discussion of this question, see Chap. ix., below.

⁴ For details of comparison, see Dominions Commission, Minutes of Evidence, New Zealand.—Christchurch, J. C. N. Grigg. Witness stated that it costs £10 more per annum to maintain a cow in Great Britain than in New Zealand, on account of differences in climate and feeding (Q. 2523).

Thus in 1905 the ratio of sheep and lambs slaughtered for food purposes was about 25% of the number enumerated, while in 1913 it was about 30%, and in 1914 about 35%. The production of mutton and lamb for export has developed into a thoroughly intensive industry, utilising high-priced land with fodder and root crops for fattening purposes. In this respect New Zealand is exceptional among sheep-farming countries.¹ In point of fact, in recent years intensive sheep farming has been invading arable land, formerly used for wheat production on the Canterbury Plains.²

In New Zealand pigs show a distinct downward ratio. Owing to the absence of large supplies of feedstuffs for pigs (maize, barley, potatoes, etc.) as compared with certain other countries, pigs are in competition with calves for the skim milk by-product from butter factories, and as it is now profitable to raise the latter, the number of pigs is thereby limited. The recent great expansion of cheese manufacture has further reduced the quantity of pig-feed available. It is extremely doubtful whether pig-raising for export will reach any considerable proportions for some time to come, for a number of reasons.³

With the change to more intensive forms of animal industries, New Zealand is faced with a shortage of agricultural labour and its high cost. A number of witnesses before the Dominions Commission in New Zealand emphasised this point.⁴ The labour difficulty is increased by the fact that experienced workers tend to settle on the new holdings created by the cutting up of estates and the opening up of new land. The progress of meat production and of dairying depends largely upon an increase in agricultural hands and settlers. The fact that the milking machine is proving satisfactory will help to relieve the situation in dairying, but not for long, because female, and even child labour, has hitherto been freely used for milking. The European War has temporarily withdrawn a body of mobile labour from the country, and it remains to be seen whether immigration of the right kind will be sufficient after its close to enable the New Zealand animal industries to reach their full productive power. The figures in the table above for gold exports show that a con-

¹ U.S. Year Book of Agriculture, 1914, pp. 335, 336.

² Dominions Commission, Minutes of Evidence, New Zealand.—Evidence of G. R. Marshall and E. Hall.

³ In addition to shortage of feed materials for pigs, further disadvantages are :—

- (1) The scattered nature of the pig-raising industry, making concentration for slaughtering difficult.
- (2) The high cost of labour required for feeding and curing.
- (3) Widespread tuberculosis among the animals, because they are fed on mixed skim-milk.
- (4) The distance of New Zealand from European markets as compared with other competing areas.

⁴ See Dominions Commission, Minutes of Evidence, New Zealand.—Evidence of G. R. Marshall and Edwin Hall.—“ There is no doubt that the fear of labour difficulty defers many farmers from doing a good deal of productive work which otherwise would be undertaken ” (Q. 2788, p. 166).

siderable decline in gold mining has taken place since 1902, but even this has not set free enough labour to fill the growing requirements of agricultural industries; and an increase in local manufacturing industries in the future (though not so probable as in Australia) will, of course, in the absence of heavy immigration, increase the labour difficulty on the farms.

So far as resources alone are concerned, various authorities are agreed that there is room for a moderate expansion in the animal industries of the country,¹ though the two leading branches, namely, sheep-rearing for meat-production and dairying, will in future be somewhat in competition with each other.²

AUSTRALASIA.

REVIEW AND SUMMARY.

Australia and New Zealand occupy an important place among the world's surplus-producing countries in meats and dairy produce. On a basis of values, they supplied in 1913 rather more than one-fifth of the meat imports of the United Kingdom, and about the same fraction of the butter and cheese imports. A study of the figures for international trade in these animal foodstuffs shows that Australasia now supplies somewhat less than one-fifth of the world's exports.³

From the point of resources, it is evident that Australia and New Zealand can increase their exports in both meat and dairy produce for many years to come. Neither country, especially Australia, is as yet fully developed, and it will be a long time before either of them becomes filled with population to such an extent as to cause home consumption to check exports in animal foodstuffs. Manufactures are at present of small importance, and are not likely to increase to any extent, except in certain limited areas in Australia. The present conditions in both countries are such that any increase in population suitable for local conditions will lead to a more than proportionate increase in the surplus of animal foodstuffs. Intensive methods in various forms are being introduced in Australasia, and the possible future output may be greatly increased by their further adoption. Owing to the high cost of labour and the comparative absence of large areas of unoccupied productive land, there is no likelihood whatever that these countries will supply great quantities of animal produce at dumping prices. It is, nevertheless, quite likely that they will come to supply a greater fraction of the international trade in meat and dairy produce than at present, and that their supplies will be more regular from season to season.

¹ See U.S. Year Book of Agriculture, 1914, p. 337 and pp. 421-8; also Dominions Commission, Final Report (Cd. 8462), pars. 123-138.

² See Dominions Commission Minutes of Evidence, New Zealand (Cd. 7170), QQ. 2290 and 2525; also U.S. Dept. Agric., Bureau of Crop Estimates, Report 109, p. 184.

³ Omitting live animals for meat-producing purposes.

The possible recurrence of serious droughts in Australia is a factor that may check normal expansion, though the consequences of these visitations may not be so disastrous as previously with the progress of settlement and agricultural science. The general change from wool sheep to mutton sheep throughout the world may bring about a shortage of wool, which in its turn may check the exports of lamb and encourage a return to merinos. The quality and quantity of the mutton exported may thereby be adversely affected. The progress of wheat cultivation in Australia is hardly likely to exercise competition with the production of animal foodstuffs, nor is there any other notable competing agricultural industry in either country. The dairy industry has recently made rapid progress in both Australia and New Zealand, and will almost certainly continue to do so in the near future. On the whole, it appears probable that the world-prices for meats and for dairy produce in the future will be high enough to stimulate a more rapid advance in the animal industries of Australasia than has hitherto been the case, provided they are not unduly handicapped by conditions of labour shortage.

SURPLUS PRODUCING REGIONS.

(g) EASTERN EUROPE.

The region here taken is that defined as Eastern Europe in Chapter II., and includes as the most important countries, from the point of view of this inquiry, Russia, Hungary, Roumania and Bulgaria. Directly, the contribution of the whole of this large region to the world's exportable supplies of animal foodstuffs is not great, indirectly, it is of striking importance.

With the exception of certain egg and poultry exports from Russia and Galicia, the only part of Eastern Europe that has any regular surplus of animal foodstuffs is Hungary, which has sufficient animals¹ to allow of some meat exports to Austria and to Germany. Otherwise the animals raised throughout do little more than furnish the supplies required for the prevailing rather low average standard of consumption of meat and dairy produce.²

The predominant form of agriculture in Eastern Europe everywhere is cereal cultivation. The population is sparse relative to the productive area, compared with Western Europe, so that there is a considerable surplus of grain for export trade. This region may be contrasted with New Zealand, which, as shown above, devotes almost all its resources, beyond those required to meet the local consumption of food cereals, to animal industries; while Eastern Europe devotes most of its resources to cereal cultivation, and, poultry excepted, raises few more animals than are

¹ See Part I., Chap. vii., below p. 136.

² In 1912 Russia imported 136 million lbs. of meat and meat products, while exporting 55 million lbs., the deficiency amounting, therefore, to 81 million lbs.

sufficient on the balance to supply the local demand for animal foodstuffs.

Wheat and rye, which are used mainly for direct human consumption, are large items in the cereal export trade of Eastern Europe; but more interesting from the present point of view, is the surplus of oats, barley, maize, linseed and other oil-seeds, and oil-cake, that finds its way in normal times into international trade. The output of these materials was increasing in the years prior to the War¹, and in 1913 the exports of them from the above-mentioned countries amounted to an important part of the world's total exported supplies. In fact, when the quantities of oats, barley, maize and maize meal and oil-cake and meal, exported from Eastern Europe in 1913, are expressed in tons,² it is found that, together, they amount to 7·43 million tons out of the world's total exported surplus of 22·7 million tons, or approximately 33%, as shown in the following table :—³

	OATS	BARLEY	MAIZE AND MAIZE MEAL	OIL CAKE AND MEAL	TOTALS
Exports from Eastern Europe	·91	4·6	1·2	·72	7·43
World's total	4·23	6·64	9·0	2·8	22·7

If it is assumed that the whole of these exports from Eastern Europe was used as animal feedstuffs in the countries receiving them, it would follow that the addition thereby made to animal food supplies was considerable. In practice, of course, some part of the supplies of these articles is diverted from consumption by food-producing animals. On the other hand, the exports of wheat and rye contained feedstuffs in the form of milling offals, which may be reckoned at about a quarter of their weight, and in addition the Russian exports of bran and pulses mentioned above should be allowed for. The total exports from this region in 1913 of materials used as concentrated feedstuffs for food-producing animals, therefore amounted probably to not less than 8 million tons. If 7 lbs. of these feedstuffs are taken as capable on an average of producing

¹ In Russia and Poland, between 1890 and 1910, the per capita production of maize rose from ·3 to ·6 bushels, of oats from 6·9 to 7·0 bushels, and of barley from 1·9 to 3·3 bushels.

² The following conversion co-efficients have been used for this purpose : — 1 bush. oats = 40 lbs. ; 1 bush. barley = 50 lbs. ; 1 bush maize = 60 lbs.

³ The trade in cereals and feedstuffs between the countries of Eastern Europe (which would be included in the above totals) is not great and would be largely balanced by the inclusion of Austria with Hungary.

1 lb. increase in the live weight of meat animals,¹ and if dressed meat is taken to average 60% of live weight,² the above total of 8 million tons would yield about 685,000 tons of meat, or more than one half of the total meat imports of the United Kingdom in 1913. The importance of these exports of animal feedstuffs from Eastern Europe was not perhaps generally recognised in its bearing upon the production of meat in Western Europe, especially in the United Kingdom and Denmark.

Whether these supplies will be available to the same extent in the future is a question that requires examination. Much of the land suitable for cereal production is already occupied, except towards Northern Russia, where forests still cover land upon which oats and barley might be grown. Such land will probably be brought steadily into cultivation, though the rate of progress cannot be rapid, since years must elapse between the felling of the timber and the first ploughing for crops.

The fact that such large exports of cereals have been possible for many successive years is due to the Black Earth soils of Russia and to the loess soils of Hungary, Roumania and Northern Bulgaria. However, the fertility of such soils suffers from continuous cereal cropping. They are apt to become poor in phosphates,³ and consequently the use of artificial fertilisers or an extension of animal-rearing becomes essential for the maintenance of productivity. Artificial manures, though more widely used in recent years⁴, are still little known in Russia and transport difficulties, as well as high prices for imported fertilisers, stand in the way of their extended use. Unfortunately, also, the great cereal districts have few sheep⁵ or cattle⁶ which might assist in maintaining the fertility. The average yield, therefore, in Russia is very low, though it shows a tendency to rise.⁷ In Hungary and Roumania the average yields are higher owing to a greater average fertility of culti-

¹ This seems a fair average for cattle, sheep and pigs. Under favourable conditions pigs and young stock of other kinds require less than 7 lbs. of concentrated feedstuffs to produce 1 lb. increase in live weight, while steers require more.

² From information supplied by British and American official papers, the following proportions of dressed to live weight appear representative:—for cattle, 60%; for sheep 50%; for pigs, 75–80%.

³ The following estimate has been made of the net loss of Russian soils in phosphoric acid per annum:—

Annual withdrawal per cereals	= 666,000 tons
„ return to soil	= 185,400 „
Annual deficit	480,600 „

Extract from U.S. Daily Commerce Report, April 27th, 1912.

⁴ Report of British Consul at Moscow for 1911 (Cd. 6665–130), p. 7.—“The use of mineral manures . . . has made great strides.”

⁵ See Daily Commerce Reports, Oct. 6th, 1910, p. 68, where the decline in sheep in European Russia is ascribed to break-up of large estates.

⁶ J. Mavor, *Economic History of Russia*, 1914, Vol. II., pp. 285, 286.

⁷ The average wheat-yields in Russia per acre for the years 1905–14 were as follows:—average of years 1905–9, 9·3 bushels; average 1910–14, 9·6 bushels.

vated soils, better weather conditions, more intelligent methods of cultivation, more live stock per acre, and better means of communication, which make the carriage of fertilisers possible at reasonable rates.

It is quite certain that the Black Earth soils will soon show signs of exhaustion, unless different methods are followed.¹ The capital store of fertility in the form of humus cannot last there any more than has been the case in North America. The mere cultivation of these powdery soils allows the rains to wash out some of the fertility in the form of fine particles. The Russian peasant, but recently set free from the common-field system under the Mir, has not yet learned to take a personal interest in the preservation of fertility. Moreover, he is poor in resources, burdened with debt, a prey to middlemen, ignorant, and unacquainted with the more intensive methods of cultivation. The return in crops is a measure, therefore, not so much of the infertility of the land, as of the inefficiency of the cultivators.

There is evidence to show that, if the Russian soil is properly handled, it is still capable of great productivity. It is significant that the yield from the large estates is higher per acre than that from the peasant holdings.² The opinion that higher permanent yields are possible seems to be shared by Bonmariage³ in the work already quoted. In any case, agriculture is likely to remain the most important industry in Russia for many years to come,⁴ and the country as a whole will probably produce and export cereals up to the margin of its capacities. It should be remembered that the town population has been increasing more rapidly than the agricultural, but the ratio of the former to the latter is the lowest in Europe. While industrial populations in Russia are likely to increase in the future with the development of its mineral resources, it is nevertheless quite possible that increased yields under more intelligent methods of cultivation, especially with the aid of machinery, will enable it to maintain, and possibly to increase, its surplus for export trade. Some internal changes in the distribution of Russian agricultural industries may lead also in this direction. Dairying is making progress;⁵ land is being sown to grass as a rotation crop⁵; and less flax and hemp are being cultivated in the north and north-west.⁵ Much may be expected from Government educational propaganda among peasants, and still more from the

¹ Dr. A. Bonmariage, *La Russie d'Europe*, 1903, p. 317.—“It will soon be necessary to modify these methods of exploitation (on the Black Earth), if one does not wish to ruin completely this land, so rich and so fruitful.”

² J. Mavor, *op. cit.*, Vol. II., p. 283.

³ Bonmariage, *op. cit.*, p. 316.—“Under more intelligent methods of cultivation and a more rational system of exploitation the Black Earth alone could provide sufficient food for the whole of Russia.”

⁴ Bonmariage, *op. cit.*, p. 508.—“Agriculture will be for a long time to come the principal source of the Empire's riches.”

⁵ Report of British Consul at Moscow for the year 1913, pp. 16, 17.

rapidly developing agricultural co-operative societies.¹ Nevertheless, it would be unwise to expect too much from reforms and changes in the economic position or methods of the Russian peasant.² The other countries (Hungary, Roumania, Bulgaria) may be expected to maintain their present average surplus of cereals for some time to come.

With the exception of poultry-rearing, which is widespread, animal industries are generally backward in Eastern Europe, as already indicated. The numbers of live stock appear large,³ but are not a clear index of the relative position of the countries in that region among producing areas, because the animals are often poorly cared-for, and many of them are of an inferior type.⁴ The meat-producing capacity per unit of live stock is probably much lower than in Western Europe or North America. Moreover, in European Russia, the ratios of food-producing animals to the population are lower than in most European countries, and have declined; the number of "cattle units" per 100 of the population which stood at 57 in 1890, fell steadily to 41 in 1913.

The smallest number of cattle is found on the Black Earth zone,⁵ where the conditions are said to be not altogether unfavourable to cattle-rearing.⁶ The greatest number occurs in Southern and South-Eastern Russia,⁷ where the climatic conditions, resembling those of Central Asia, are unfavourable to the production of first-class animals. Sheep are more numerous on the Black Earth zone than elsewhere, but are being driven by the increase of arable to the cheaper lands of Northern Caucasus.⁸ More attention has recently been given to the production of bacon, of which certain quantities have been exported,⁹ and this trade, if resumed later, may have the effect of increasing the numbers of pigs, though there was apparently a decline in these animals in the years prior to 1914.

An important industry in the grain-growing district of Russia is the production of poultry and eggs of which large quantities have

¹ Report of British Consul at Moscow for the year 1910, p. 8.—"The year 1909 was especially rich in examples of all sorts of co-operative work in connection with agriculture."

² See American *Economic Review*, March, 1916, p. 68.—Review of book, *Bauernfrage and Agrarreform in Russland*."

³ According to the latest available estimates, Russia, Roumania, Bulgaria and Hungary together had about 46 million cattle, about 67 million sheep, and about 21 million pigs.

⁴ Some of the cattle are kept for draught purposes, and the distinction between sheep and goats is not always precisely made, at any rate, in Russia.

⁵ Mavor, *Economic History of Russia*, Vol. II., p. 284.

⁶ Bonmariage, *La Russie d'Europe*, p. 517.

⁷ *Ibid.*, p. 517.

⁸ Mavor, *op. cit.*, Vol. II., p. 284.

⁹ Report of the British Consul at Moscow for the year 1912, p. 8.—The chief centre in European Russia is Tambov. The Russian exports of pig-meat in 1912 amounted to 12,788 tons, some of which was probably of Siberian origin.

See also *Statistical Journal*, Mar., 1917, pp. 194, 195., in an article dealing with the Economic Resources of Russia by Baron Heyking.

been exported.¹ In this respect alone, Eastern Europe, including also Hungary and Galicia, occupies a prominent position as furnishing a surplus of animal foodstuffs. Eggs may be taken as having at least the same food value as meat with bone, weight for weight. It will be seen that the egg exports from Russia in 1912 were thus equivalent to at least 120,000 tons of meat,² or about one-tenth of the total pre-war meat imports of the United Kingdom. The importance of this item should not be overlooked in dealing with animal food supplies. The poultry industry may develop in the future, possibly at the expense of cereal exports, but for the present it is held in check by lack of technical knowledge and of proper organisation.³

Russia is unable to supply its requirements in beef without drawing upon Siberian sources.⁴ In any case, the Russian cattle trade lacks the organisation found in other countries having better means of transport, with the result that the home market requirements are not always properly supplied.⁵ The resulting fluctuations in prices must have a very discouraging effect upon production.

Sheep raising in Eastern Europe is centred in Southern and South-Eastern Russia and in the mountainous country round the Carpathians and the Balkans. Russia apparently has a large number of animals enumerated as sheep, but the Russian unit of sheep + goats is much inferior in meat-producing capacity to the sheep unit in other countries. That these sheep are of low-grade quality is borne out by the fact that much of the wool is very coarse, and that, till recently, the manufacture of tallow was an important industry in Northern Caucasia.⁶

¹ According to the report of the British Consul at Moscow for the year 1909 (p. 15) the number of geese and fowls exported from Russia in 1907 was about 5 million.

The exports of eggs have been as follows:—1910, 2,998 millions; 1911, 3,682 millions; 1912, 3,396 millions.

² Estimating, say, 12 eggs = 1 lb. The surplus from Austria-Hungary was nearly as large.

³ Report of British Consul at Moscow for 1912, p. 22.—“It is the egg industry that is really the cause of the activity in farming. The industry would be in a far better position were it not for the general ignorance of the principles of poultry farming and for the absence of organisation.”

⁴ See Report of British Consul at Omsk, Siberia, for 1913, in which the following statement of meat exports (mainly to Russia) is given:—

1909 = 1·82 million poods = ca. 30,000 tons.

1912 = 2·615 „ = ca. 42,000 „

⁵ In 1910, for example, there was “a lack of organisation and union between centres of cattle and meat production and the inner markets and centres of consumption.”—Report, of American Consul-General at Moscow in U.S. Daily Commerce Reports, Oct. 14th, 1911, p. 233.

See also remarks by British Consul at Moscow, in his report for the year 1910.—“The cattle and meat trade seems to have shown want of organisation, and the abnormal conditions were evidenced by the import of Australian mutton on the one hand, and on the other, by an increased export of Siberian pork and Central Russian bacon.”

⁶ At Nakhitchevan, U.S. Daily Commerce Report, Sept. 11, 1913, p. 1438.—The decline in sheep is indicated by Russian tallow imports, which

The whole region under consideration has a more or less continental climate, in which the regular mild oceanic rainfall that characterises North-Western Europe, is absent. In general, the active growing period during the late spring and early summer months under the stimulus of summer rainfall, and the almost complete cessation of plant growth during five or six winter months, make this region more suitable to cereals than to domestic animals. Natural pastures may be very luxuriant during a few months in the year, but, owing to the dryness and heat of the late summer and the intense cold of the winter, may be quite deficient during the rest of the year. Without shelter and stall-feeding for many months in each year, it is impossible to raise first-class animals, and these methods are more or less unknown, simply because land can be put to readier uses, under the present economic conditions of the people, in growing cereals and rearing poultry. When these peoples have reached a much higher standard of life than at present, and intensive methods of cultivation, the utilisation of machinery, and the science of animal husbandry are much better understood, there may be changes in the direction of a greatly increased surplus of meat and dairy produce. Europe between the Urals and the Carpathians is still largely undeveloped and progress in agriculture awaits further railway construction and technical developments.

On the other hand, such progress will probably mean some increase in the standards of consumption among the population, which are at present low. The Russians are said to be fond of meat,¹ and any improvement in their economic position would probably be reflected in an increased meat consumption per capita. The supply of river fish, an important source of food in Russia, is said to be declining, owing to pollution of the waters by factories, and this, if continued, will bring increased pressure on the meat supply. Moreover, population increases rapidly.

The question of the possible future meat supplies from Eastern Europe is thus seen to be complicated.² On the balance, however, there does not seem to be much likelihood of any notable surplus in ordinary meats during the next two decades. Poultry and egg production, already considerable, will probably advance, and dairying may soon become a much greater industry than at present. There is not much doubt that Eastern Europe will continue for some time to be one of the world's great sources of surplus wheat and feedstuffs.

amounted to 41,000 tons in 1912.

Cf. also the following:—"Very little is being done to increase the quality of either the breeds of sheep or the classes of wool and both are gradually depreciating from in-breeding. . . . The hard winters and the short herbage of the steppes render it necessary to have only the hardiest breeds."—British Cons. Rept., Moscow, 1913 (Cd. 7620-25), p. 27.

¹ Bonmariage, *La Russie d'Europe*, p. 522.

² Hooker, *Statistical Journal*, June, 1909, p. . . .—"The future of Russia as a purveyor of meat is an unknown quantity."

SURPLUS-PRODUCING REGIONS.

(h) SIBERIA.¹

Siberia has been the latest of the existing large surplus-producing countries to be opened up to international trade, and the process is still in progress. The area of land available for agriculture is apparently enormous, and the population still scanty in most parts, so that an increasing surplus of agricultural and pastoral produce may be exported thence in the future. These surplus exports fall under three heads, namely: cereals for human consumption; animal feedstuffs; and animal produce, including butter, eggs, pig-meat, and beef and beef-cattle, sent either to Russia or to foreign countries.

The area of fertile land favoured with temperate climate conditions is not more than 500,000 square miles,² of which about 200,000 square miles are in Western Siberia. The progress of settlement since the year 1900 has been rapid in Siberia, though droughts in that country and economic changes in Russia have combined to check the stream of new arrivals.³ The above estimate concerning the area of available agricultural land must be considered with reserve in view of the facts; first, that much of the unoccupied land is now covered with forest,⁴ which hinders rapid settlement, however productive the land may be;⁵ and second, that most of the land near the railways and navigable rivers has already been taken up,⁶ and land lying more than 100 to 150 miles from these lines of communication is, generally speaking, except perhaps for the winter transport of butter, beyond reach of the world's markets.⁷

¹ In practice it is not always easy to distinguish Siberian exports from the Russian. Siberian butter, eggs and pork generally pass through Russian Baltic ports and are apt to be included with Russian figures.

² *Encyclopedia Brit.*, 1911 Edition.—However, a German investigator (Clemens Brandenburger, in *Angewandte Geographie*, 1905) estimates the area at about 800,000 square miles: "The agricultural belt of Siberia contains about 4.2 million square kilometres, of which at least one half is capable of profitable cultivation."—*Russisch-Asiatische Verkehrsprobleme*, p. 5.

³ F. Nansen, *Through Siberia*, p. 386 and p. 295.

⁴ F. Nansen, *Through Siberia*, 1914, p. 239 and p. 301.

⁵ The following table, showing the number of dessiatines of arable and pasture land per family in Siberia at the end of 3 and 19 years in different parts of the country, illustrates this point:—

	FERTILE WESTERN PLAIN	RICH FOREST STEPPIES IN EAST	NORTHERN FOREST PLAIN
At end of 3 years	17.8	8.0	4.9
At end of 19 years ...	1.83	13.3	7.1

Internat. Agric. Inst., *Bulletin of Social and Economic Intelligence*, May, 1915, p. 105.

⁶ F. Nansen, *Through Siberia*, p. 286.

⁷ *Angewandte Geographie*, 1905, "Russisch-Asiatische Verkehrsprobleme" by Clemens Brandenburger, p. 6.—"Settlements lie within the sphere of influence of the railway or of the navigable streams. This sphere of influence in view of the bad condition of the roads is strictly limited."

Moreover, it is only Western Siberia that is likely for a long time to come to be a producer of surplus foodstuffs, since in the Eastern half of Siberia, beyond the Altai region, the northern limit of wheat cultivation is 52° N.,¹ which parallel is roughly 140 miles north of the irregular Chinese frontier. Besides, the mining population of this eastern half tends to absorb an increasing quantity of locally produced and imported foodstuffs. There is, therefore, no surplus of animal produce from Eastern Siberia, and none seems likely to be forthcoming in the future. In Western Siberia, however, wheat can be grown as far north as 62° N.² Though barley, oats and rye can be cultivated further north in the Northern Hemisphere than wheat, it is not likely that permanent settlement with animal industries as a prominent feature will advance for many years to come much beyond these critical parallels.

The greatest need that Siberia has in order to secure increased agricultural production is more extended means of transport and improvement of those already in existence. The Trans-Siberian Railway was mainly a military work, and by taking a shorter route in Western Siberia, avoided some of the more fertile tracts of country. Fortunately, however, this mistake has to some extent been remedied by the recent completion of a new line (the Altai Railway) from Nikolaievsk on the Trans-Siberian south-westward through Barnaul to Semapalatinsk.³ Much still remains to be done in the construction of branch lines, and even of additional East and West Trunk Lines. A comparison between the railway map of Western Canada and that of Western Siberia will show how deficient railway transport is in the latter region. The great navigable rivers of Western Siberia, the Obi and its tributaries, relieve the situation to some extent; but the advantages of these river highways are reduced, because during the winter they are frozen, and during the summer season of navigation they have no outlet of commercial value except by the Trans-Siberian. Canalisation of the smaller tributaries is badly needed, and alternative lines of through communication are desirable; either by canal, or by shorter lines of railway northwards to Obdorsk on the Gulf of Obi or to Archangel; or westwards, using an eastern affluent of the Volga and the navigation on that river and on the Don, to the Black Sea.

Roads, also, in Siberia appear to be very poor owing to the absence of road-making material, as well as to the undeveloped state of the country and the great distances to be traversed. Such roads as exist are most serviceable in winter when frozen hard, and least so in the spring and early summer. Grain, when proper

¹ Clemens Brandenburger, article already quoted, p. 7.

² *Ibid.*, p. 7.

³ See U.S. Daily Commerce Reports, Oct. 7th, 1915.—This is an important commercial line running at right angles to the Obi, Irtysh and Yenisei, and connecting the intermediate country south of the Trans-Siberian, with the lines of navigation upon these rivers. Since 1914 a number of other new branch lines have been opened. See U.S. Daily Commerce Reports, Nov. 2nd, 1916.

precautions are taken against its becoming frozen, may be moved at leisure after the harvest during the winter months, whereas butter and eggs are produced most heavily during the spring and early summer months, and must be transported without delay to prevent deterioration; these facts, taken by themselves, may be regarded as favouring grain-growing rather than dairying in Siberia.

These limitations upon the availability of Siberian lands explain the situation that whereas, "for the present at any rate, the resources of new land are practically inexhaustible,"¹ in Western Siberia, "the supply of free and easily-accessible land which is more or less ready for cultivation, is greatly diminished,"² and that there has been a decline in immigration more recently into that region, "which already has a fairly large population, and where most of the good land is already occupied."³ To what extent and for how long the productive capacity of Siberia will continue to be limited by these circumstances are vital questions in considering the possible surplus of foodstuffs of different kinds, but they cannot be more than touched upon here.

The occupied lands in Siberia are devoted either to cereal cultivation or to pastoral industries leading to dairying. These two branches of agriculture compete to some extent with each other. The country has apparently natural advantages in parts for cattle-rearing, which is a considerable industry⁴ "on account of the abundance of rich pasture land and a plentiful supply of fodder for the winter months."⁵ Cattle diseases seem to be comparatively rare owing to the winter cold.⁶ In addition, however, to these natural advantages, dairying in Siberia has received great impetus, first, from the fact that the production of butter has become increasingly more profitable than the production of grain; second, from the use of refrigerated cars on the railway to Baltic ports; third, from the direct encouragement given by the Government to the industry in the form of financial assistance to peasants and of instruction by experts; fourth, from the introduction of the hand separator, which has made dairying for the export of butter possible in districts remote from the lines of transport; and finally, from the relatively rapid spread of co-operation on the Danish model among dairy-farmers.

As in other newly-settled prairie lands with naturally accumulated soil fertility, grain-growing has been found to be the readiest means of obtaining the quick return which the settler requires. Transport difficulties, however, have been much more severely

¹ F. Nansen, *Through Siberia*, p. 301.

² *Ibid.*, p. 286.

³ *Ibid.*, p. 302.

⁴ In 1912 Siberia exported to Russia and elsewhere over 160 million lbs. of butter (more than $\frac{2}{3}$ of the Danish exports) and about 45,000 tons of meat.

⁵ S. Turner, *Siberia*, 1905.

⁶ *Ibid.*, p. 37.

felt in this industry in Siberia than has been the case in North and South America.¹ There is no doubt that if extensive improvements are made in both the internal and the external means of transport, the effect will be to reduce the relative disadvantage as compared with other cereal-producing regions; if these improvements are directed to canals and the shortening of railway routes, as has been suggested, bulky goods such as cereals may gain a greater reduction in freight charges than butter, which must always travel through on refrigerated cars by rail as much as possible. Moreover, there is no likelihood of a market for Siberian grain in Russia, which is itself a great cereal country, while there may possibly be some market for Siberian butter.² The means of transport, therefore, control the extent of cereal cultivation in Siberia. Nevertheless, Western Siberia is well adapted to this branch of agriculture, and one writer at least, believes that it will be the leading one for a long time to come.³ The fertile area of the country is so vast and the population relatively so small, that there is room for a great expansion in both cereal cultivation and animal industries. Up to the present the latter have had the advantage in net prices. Whether the same conditions will hold after the conclusion of the European War depends upon a number of factors in combination—ocean freights, relative demand, and means of internal transport.

It will be some time before the fertility of Siberian soils is seriously affected by continuous cropping. When that stage comes, animal industries will be found the readiest means of saving the land from exhaustion, since fertilisers cannot bear the cost of transport over great distances. In recent years Western Siberia has been more and more devoted to dairy farming and the production of butter⁴ owing to the advantages already described, and this is the best guarantee for the preservation of soil fertility. The industry has also become established east of the Obi as far as Krasnoïarsk on the Yenesei and southwards for many hundreds of miles from the main railway line into the Altai region.⁵ With such widespread foundations already laid, the dairying industry is not likely to languish, even if cereal cultivation becomes profitable in the future, for three reasons. In the first place, any improvements in transport are likely to develop new and more remote

¹ The cost of transporting and marketing grain from Western Siberia to Hull was apparently upwards of twice that on grain from Western Canada or Western United States to Liverpool. More than half of the price realised for Siberian grain in England was swallowed up by these charges.

² Dairying in Russia is still an undeveloped industry, and some of the centres of population are remote from the dairying districts or are reached from them only with great difficulty. Under existing transport conditions Russian butter may in the future be exported from certain districts in Russia, while Siberian butter is being consumed in others. Politically and commercially Siberia tends to be a province of Russia.

³ Clemens Brandenburger, article above quoted.—“For at least a century to come the production of grain will dominate Siberian agriculture.”

⁴ F. Nansen, *Through Siberia*, p. 298.

⁵ S. Turner, *Siberia*, p. 50.

regions for dairy farming as the forerunner of other kinds of farming, besides improving the quality of the exports by increasing the refrigerated space available on the railways and river steamers, and by reducing the distances which butter has now to be hauled overland in sledges in the summer sun. In the second place, dairying is complementary to cereal cultivation in providing a proper rotation of crops and pasture under more intensive methods which will follow in Siberia as elsewhere with the growth of settlement. In the third place, there is every likelihood that Siberia will become an important meat-producing area. If cattle and pigs are reared and fattened in Siberia, grain, especially barley, will find a larger local market, and will thus be exported in the more convenient form of meat and meat products. The existence of dairying, with cheap cereals and abundant pastures in the same region, presents highly favourable conditions for the production of pork and beef. In this direction, therefore, much is to be expected from Siberia.

The poultry industry is important in Siberia as it is in Russia, though it has not yet reached very great proportions.¹ It is quite probable that Siberia will supply very much greater quantities of eggs to foreign markets in the future than it has done hitherto, since it will be to the advantage of Siberian farmers to forward their produce in the most concentrated and valuable forms rather than export cereals in bulk.

With reference to the probable future rate of development in Siberia in general and of its possible extent, some estimate may now be made. The limits of agricultural settlement are set by the arid steppes of Central Asia towards the South, by mountains, and by the gulf of Arctic cold to the East, and by forests and tundra beyond the 62nd parallel to the North. Within this rhomboid lie the areas where development is possible. No great permanent expansion is possible without considerable capital outlay on roads and other means of transport, on schools and hospitals, on livestock, agricultural machinery, and cold storage. It is doubtful whether capital will be available in sufficient quantities for these purposes in Siberia. In any case, the price in terms of interest may be a hindrance. America, it should be remembered, was developed during a period when supplies of capital were abundant and cheap, but in the case of Siberia the greater outlay is yet to come. Russia itself will not be able to spare much because it is also in great need of large external supplies of capital for development purposes. It cannot be presumed that Siberia will be developed as rapidly as the new countries in North and South America have been. It is possible, however, that the world-prices for animal produce will in future be much higher, and this would give Siberian farmers a stronger financial position than American farmers had, and make it easier for them to develop their land independently.

¹ The exports of eggs which in 1909 exceeded 4,200 tons in weight are some indication of the extent of poultry rearing.

In the meantime, sheep-rearing, till now a neglected industry in Siberia, might be established on sound foundations. A comparatively small capital outlay is required for this industry where land is abundant and cheap, and the steppes and mountain country of Western and Central Siberia are said to be well adapted to this branch of animal industries.¹

In animal produce it seems that Siberia is likely to increase considerably its exportable surplus of butter and of eggs, and may develop a large export trade in finished beef and pig-meat. Attention may also be given in the near future to the production of cheese² and of mutton, but the exports of these articles to countries outside Russia are not likely to be great for some time.

In any case, Siberia remains one of the few great animal-raising regions in the world of temperate climate as yet only partially developed, and, though it has undoubted mineral wealth, the increase in non-agricultural population will scarcely affect the surplus of foodstuffs for a number of years to come.

EASTERN EUROPE AND SIBERIA.

REVIEW AND SUMMARY.

The whole of this region, from the German frontier to Lake Baikal, and from the Balkan Mountains to the Arctic tundra, is a single unit from the point of view of agricultural geography. It shows certain variations in products according to soil and latitude, but the dominant features are the same throughout.

The continental climate, the level and open tracts of country, the accumulated fertility of the prairie soil, and the comparative poverty and the unskilled traditions of the people, combine together to make the cultivation of cereals (wheat, rye, barley, oats, linseed or maize, according to latitude), or of special crops such as sugar beet, flax and hemp, the leading industry. Everywhere, also, except in a few specialised mining or manufacturing districts, the population is almost entirely rural. Agriculture in its various forms is, and will remain for a long time to come, the staple industry, and the export trade of the whole region will continue to be dominated by agricultural produce.

Animal industries are in general comparatively neglected. To this statement, however, there are some noteworthy exceptions, among which the most striking are the poultry industry of Russia and Galicia, the dairying, cattle-rearing and poultry industries of Siberia, the sheep-farming on the mountain lands towards the West and South, and finally the pig-raising industry of Hungary. In the sum-total of the world's international trade, Russian and Austro-Hungarian eggs and Siberian butter have already been important items. So far as resources alone are concerned, there is no reason why these exports should not increase

¹ U.S. Daily Commerce Report, Jan. 16, 1913, p. 190.

² Report of British Vice-Consul at Omsk for 1911, p. 39.

much further in response to future demand, and there is also no reason why pig-products, and possibly also cheese, beef and mutton should not rise in export trade to some proportions.

The further development of animal industries in this region depends upon several factors which may or may not be realised in the near future. Of these the most outstanding are improvements in transport of all kinds, the provision of cold storage depots, and the adoption of more intensive methods involving a wider knowledge of the science of animal husbandry, better technical equipment, and greater adaptability on the part of the peasant farmers than they at present possess. It is interesting to note that there are signs of a coming change, shown by the spread of co-operation, the greater use of machinery, and the renewed interest in various kinds of animal industries in Russia, Siberia and Bulgaria.

For the present the leading feature is the huge export-surplus of animal feedstuffs, upon which intensive animal-raising industries in Western Europe have been dependent in no small measure. The total value of these exports of feedstuffs, when converted into terms of meat, is very large—much greater than the total meat exports from South America in recent years.

With regard to the future, though threatened soil exhaustion may reduce the total output, it is just as likely that internal changes in the methods of production, leading to the maintenance of food-producing animals, together with crop-production, will enable this region to maintain, and perhaps to increase, its surplus both of cereals and of animal foodstuffs. Large areas in Siberia are at present undeveloped or are not producing to their full capacity, and this statement is also true of parts of Russia. The tendencies are in favour of finished animal produce replacing cereal foodstuffs in the export trade to a limited extent; and the difficulties and cost of transport will favour this movement. Droughts are not unknown in various parts of this region, and the surplus of cereals, whether foodstuffs or feedstuffs, is accordingly liable to fluctuations. It is not likely that in the near future non-agricultural population will advance rapidly enough to cause any serious reduction in the exportable surplus of animal produce together with feedstuffs from this region.

NOTE.

The above account of the conditions in Russia and Siberia has been written without reference to the changes that may be brought about either temporarily or permanently, as a consequence of the European War. These changes may or may not be far-reaching. The future economic development of Russia and its erstwhile dependencies is now more than ever difficult to foretell. When, however, their agricultural industries are re-established, they are likely to follow the lines indicated above, marked out by geographical and other conditions.

SURPLUS-PRODUCING REGIONS.

(i) MISCELLANEOUS COUNTRIES OF TEMPERATE LATITUDE.

The remaining areas in the temperate zones that have some surplus of animal foodstuffs are individually of minor importance, but taken together they contribute an appreciable share of the world's total supplies of animal produce and feedstuffs.

In the countries of Northern Africa, bordering on the Mediterranean, the most important food-producing animals are sheep and goats. These animals are reared extensively in Algeria, which has a surplus of upwards of a million sheep annually for export to France. Morocco also, in its highland pastures, has conditions suitable for the raising of sheep, and a surplus of meat either live or dead, may be exported when the country becomes developed under a more settled government, as it eventually, but probably not immediately, will be. The more easterly countries of Northern Africa, from Tunis to the Suez Canal, have shown but a very small development in meat-producing animal industries, owing to the prevailing semi-arid conditions. Their strength lies more in the rearing of draught animals and beasts of burden, such as mules, donkeys and camels.

British South Africa, South of the Tropic of Capricorn, is largely a pastoral region, and with the exception of the eastern coastal districts, must remain so in the future. Only a very small fraction of the whole area is suitable in soil and climate for agriculture. It appears that the cultivation of crops is restricted by the marked absence of humus in the soils and their low capacity for retaining moisture.¹ The Dominions Commission, though reserved in stating their conclusion, seem to be of the opinion that South Africa is better suited for animal industries than for crop-production.² Other authorities are more emphatic concerning the advantages of South Africa for pastoral industries as compared with crop-cultivation.³ On the whole, it appears that hitherto all farming industries have been somewhat neglected in South Africa owing to the great development of mining.⁴ Droughts and animal diseases are the chief obstacles to rapid progress in the agricultural output. The cultivation of crops is especially affected by the former, as well as by other factors, such as the impossibility of growing quick cash-crops as in other new countries, the lack of sufficient internal means of transport, and the native labour problems. Animal industries

¹ See Owen Thomas, *South Africa*, 1904, pp. 12-14.

² Dominions Commission, Third Interim Report, p. 30.—“It may be that the main future of farming in the country lies rather in scientific stock-raising than in other forms of agricultural development.”

³ See in this connection :—Owen Thomas, *South Africa*, 1904; Bryce, *Impressions of South Africa*, 1898; A. D. Hall, *South Africa*, in the *Oxford Survey of the British Empire*, Vol. III., Chap. v.

⁴ Dominions Commission, Third Interim Report, p. 11.—“The permanent prosperity of the country also demands urgently the further scientific development of its agricultural wealth.”

are more afflicted by diseases and pests in South Africa than perhaps in any other region of temperate latitude ; and they are also held in check by droughts and by the difficulty of finding on the veldt fodder crops that will remain green during the winter. It is possible that the progress of veterinary science and the practice of more careful methods by stock farmers will do much to check in the future the ravages of destructive diseases among sheep and cattle.

Under the present circumstances the meat, butter and cheese produced locally in South Africa is not sufficient to meet the requirements of home consumption. Small shipments of beef have been made from Natal, but it is thought that since South Africa has to import both meat and dairy produce, the interests of South African consumers would be injured if any extensive meat export trade were developed at the present time. Indeed, South Africa with its great mining centres bears more resemblance, as has already been noted, to the deficient industrial than to the surplus-producing countries.¹

It is true that this region is a considerable exporter of wool ; owing to its semi-arid climate, its strength lies rather in wool and hair producing breeds of animals (merino sheep and angora goats) than in meat producing breeds. It thus bears a close resemblance to Australia, though it is never likely to have as great a surplus of animal foodstuffs as the latter. South Africa also resembles Australia in that dairying has been established along the south-eastern coastal strip where the conditions are "extremely well suited for the breeding and raising of dairy stock."² South Africa, however, differs from Southern Australia in its conditions of rainfall. Except for the extreme south-western district round Capetown, the former is characterised by a summer rainfall, while the latter receives most of its rainfall in winter. It should be noted that practically the whole of the Australian State of Victoria, which is relatively the greatest dairying state in the Commonwealth, lies south of the latitude of Capetown. The main Dividing Range in both South Africa and Southern Australia lies near the south-east coast, but this circumstance affects the annual rainfall of the westerly districts more adversely in South Africa than in Australia, owing to the difference in the direction of the rain-bearing winds. On the other hand, while the centre of South Africa is occupied by a plateau favourable to precipitation, the centre of Australia consists of a depression whose rainfall is further diminished by the

¹ Till the year 1914 the net imports of animal foodstuffs into South Africa were considerable, but they have since declined rapidly. According to the Final Report of the Dominions Commission the value of the total imports of this class declined from £1.18 million in 1913 to £0.88 million in 1915, notwithstanding the rise in prices. There appears to be every prospect of the Union becoming independent of outside sources for its supplies of all animal foodstuffs, except, perhaps, pig-meat. It may indeed have a permanent exportable surplus of beef and dairy products in the future.

² Dominions Commission, Third Interim Report, p. 31.

fact that it is flanked on either side by the great angles of the Continent that project into the Southern Ocean. The conditions for stock-rearing, therefore, grow steadily worse in South Africa towards the west, and in Southern Australia towards the centre. Like Australia, South Africa has resources in stock-raising for food production, as yet not fully developed; but specially adapted scientific methods are more urgently necessary in South Africa, and these mean considerable well-directed government expenditure and a high degree of intelligence among stock-farmers. The latter may be difficult to secure in South Africa, with its considerable proportion of native stock-owners and the general reliance of European farmers upon native labour. When stock-rearing is more fully developed in the tropical highlands of Rhodesia¹ and of other northern districts, supplies of meat may be drawn thence by the great mining towns. This would relieve the situation in the Southern Provinces, which, with improved means of internal transport, with dry-farming, fodder crops and irrigation, "may even be enabled to enter the world's markets as a competitor with Australasia and the Argentine."²

With reference to German South-West Africa, whatever its political future may be, it seems that this area will follow the same course of agricultural and economic development as British South Africa, since both belong to the same climatic region, and have extensive mineral wealth. Stock-raising has already been established in the highlands of the interior, and mining is, of course, an important industry. Under favourable conditions, there may be some exportable surplus of beef and mutton in the future, as from British South Africa, but this surplus is never likely to be very great.

China, which lies very largely within the temperate zone, has considerable interest from the point of view of this inquiry, as regards both the present export surplus and future possibilities. In one direction, namely, poultry farming, it is already a most important producer, both for home consumption and for export trade.³ Pigs are said to be numerous in the South-Eastern Provinces, and some cattle are raised in the same district.⁴ Sheep seem to be generally neglected, and neither beef nor mutton is consumed to any extent by the people.⁵

¹ See the section on Rhodesia, Chap. v., below.

² Dominions Commission, Third Interim Report, p. 31.

³ "For hundreds of years China was the greatest poultry-producing nation in the world, and probably this is true to-day, not only as regards the total production, but also in per capita use. . . . For considerable portions of the population poultry is the only animal food used, and for the more well-to-do classes it is an ordinary meat diet the year round. . . . The surplus of poultry and poultry products which China can export annually is enormous." U.S. Daily Commerce Reports, Aug. 7th, 1911.

⁴ In Kwang Si province cattle, pigs and poultry are raised for export.—U.S. Daily Commerce Reports, Oct. 19th, 1911, p. 330.

⁵ Mutton appears to be distasteful to both the Chinese and the Japanese.

China is essentially an agricultural country, and concentrated foodstuffs, with the exception of fish, poultry and eggs, enter very little into the dietary of even the wealthier classes. Cereals and other vegetable foodstuffs form the great bulk of the nourishment of the masses. China, indeed, illustrates the operation of a law in agricultural economics, already referred to.¹ Given a certain level of technical science and equipment, as population advances beyond a particular density in relation to the land area upon which it lives, cereal cultivation constantly encroaches upon the available pastoral areas, unless imports of foodstuffs² relieve the situation. In the last resort nearly the whole of the available productive land is under crop cultivation. The less fertile hillsides and mountains, instead of being covered with pastures, are devoted to forests and forest plantations, which in the case of China do not supply sufficient timber for the requirements of the population.³ Domestic animals can then be raised only by hand-feeding methods on the products of crop-rotations on the fully occupied and carefully cultivated land. This explains the predominance of "farmyard" animals, such as pigs and poultry, in China, and the absence of the larger pasture-feeding animals, such as cattle, sheep and horses.⁴

The remarkable density of population in China is not only an effective bar to the development of large exports of animal foodstuffs, but is also an obstacle to the necessary technical improvements. The present methods of cultivation are almost everywhere primitive,⁵ as regards the production of staple articles of food. The only advantage possessed by China in this respect relates to products where much human labour is necessarily employed in care and cultivation. It follows, therefore, that poultry produce, together with rice, tea, and silk, will remain as Chinese specialities. The surplus in poultry produce depends on the methods of cereal cultivation since the needs of the human population tend to be satisfied before the surplus grain is turned over to poultry.⁶ Any improvements in the present agricultural methods are likely to be gradual, and if effected, the increased return would tend to be absorbed for some years by capital-charges and by a rise in the present apparently low standard of living. The possible development of manufacturing industries upon the rich coal-fields of the

¹ See p. 39, above. For a further discussion of this point, see p. below.

² These imported foodstuffs may, of course, consist of animal produce, cereals, or animal feedstuffs in different proportions according to local conditions.

³ See A. Little, "The Far East," in the *Regional Geography Series*, pp. 98, 99.

⁴ Owing to the small size of the Chinese holdings, draught animals are not widely used for cultivation, which seems to be generally done by human labour.

⁵ See U.S. Daily Commerce Reports, April 29th, 1911, pp. 447-456.

⁶ It is, of course, doubtful whether the total output of cereals in China can be materially increased in the future by labour-saving methods; but the adoption of such methods would set free labour for other productive purposes leading to exports, which might give the country purchasing power to buy imported cereals.

country might not help to increase the exports of foodstuffs.¹ On the other hand, exports of coal are likely to precede and accompany the growth of manufactures, and the latter would tend to supply the home market with cheap supplies of the much-needed labour-saving agricultural machinery.

With reference to the Chinese exports of animal foodstuffs, the following figures² show the position, and the progress made, in the years preceding the outbreak of the European War.

	Egg and Egg Yolks	Meat and Game	Lard	Cattle Sheep Pigs	Poultry	Totals
1907 £ mill.	·39	—	·11	·55	·055	1·105
1911 £ mill.	·52	·24	·18	·56	·062	1·562

It is significant that, except for meat and game, which is a new feature in export trade, the only item that shows a marked tendency to increase is eggs and egg yolks. Chinese exports of the above-classified animal foodstuffs have been noted for their low price, which is due primarily to low-grade quality, arising from the unscientific methods of animal and poultry-rearing, but also to the absence of government regulations and inspection,³ and the peculiarly low internal currency values. Eggs are apparently very imperfectly graded,⁴ pigs are kept under insanitary conditions, and cattle are undersized and lack condition. It is probable also that any considerable withdrawal of egg supplies for export will have the effect of raising the price above the present level.⁵ The lard exported from Southern China is more or less a by-product from the brisk local demand for pork.⁶ It seems certain that any improvements in the quality of pigs and cattle products in accordance with the requirements of European and North American markets, would involve an increase in the cost of production. It does not appear either that there is any great immediate probability of improve-

¹ Chisholm, *Commercial Geography*, 7th Edition, pp. 406, 407.—“This (manufacturing) population will be dependent upon supplies of foodstuffs brought from elsewhere, possibly from a distance, and it is extremely doubtful whether China herself will be able to meet this demand.”

² Taken from the China Year Book, 1912.—The values have been converted from Haekwan Taels at the rate of 6·15 to the £ for 1907, and of 7·44 to the £ in 1911.

³ See U.S. Daily Commerce Reports, Jan. 23rd, 1911, p. 283, which notes the slackness of the Chinese Authorities in complying with cattle quarantine regulations in export trade to the Phillipines.

⁴ U.S. Daily Commerce Reports, May 10th, 1913, p. 732.

⁵ U.S. Daily Commerce Reports, May 10th, 1913, p. 733.

⁶ U.S. Daily Commerce Reports, July 10th, 1915, p. 168.

ments in the breeds of such live-stock as cattle and pigs.¹ It will be observed that the total exports of meat products and of live animals in these classes is small, as shown in the table above; and the general conclusion seems to be that there is no great likelihood of much increase in the future.

There is, however, a distinct likelihood that with improvements in railway transport, such as are now in hand, poultry and egg-production will increase greatly and lead to a larger exportable surplus; especially if cheap supplies of cereals, such as wheat, barley and maize can be imported from abroad or brought from Northern China, as some relief to the somewhat overtaxed agricultural resources of the densely peopled areas of Central and Southern China.

China seems to be well adapted to poultry-farming, and has, in fact, given several breeds to the world.² The cheap domestic rural labour of the Southern Provinces gives the country an essential advantage in this industry, where an abundance of attention—not necessarily skilled—is required.

In the production and export of animal feedstuffs the Chinese Republic, including Manchuria, occupies an important position. The growth of oil-crushing industries in Europe and North America has given rise to considerable exports of ground-nuts from China Proper and of soya beans from Manchuria. Both of these articles are imported mainly in the raw state, and are used for making refined oils for the margarine and soap trades, thereby relieving the world's butter-producing and tallow-producing resources to some extent, while the cake by-product makes a valuable concentrated feedstuff for cattle. The exports in recent years are shown in the table below (in 1,000 tons).

	Beans	Ground Nuts	Bean Cake	Sesamum	Cotton Seed	Seed Cake	Totals
1907	80	5	243	44	24	59	455
1911	657	64	619	123	13	66	1542

It will be observed that these exports rose rapidly during the four years under review, and that in 1911 they amounted together to more than 1½ million tons. If the proportion of feed materials available from the beans and the various kinds of seeds is estimated at 50%, then the total equivalent weight of animal feedstuffs exported from China in the year 1911 was over 1 million tons. This quantity, if fed entirely to meat-producing animals, would,

¹ U.S. Daily Commerce Reports, Jan. 23rd, 1911.—“Apparently there is little chance of improving the breeds of cattle in Southern China. Foreign stock is practically unknown, and in any event at present is unattainable by the Chinese farmers.”

² Such, for example, as Pekin and Mandarin ducks and Cochin and Lanshan fowls.

on the basis of the conversion formula above used,¹ yield over 95,000 tons of dressed meat. In addition, the original materials exported from China in 1911 would have contained not less than 400,000 tons of vegetable oils.

Since the climate and the soil are both favourable to the raising of these crops in their respective areas of production in China, it is probable that an increased demand from the outside world, together with better means of internal transport, will cause the extensive exports in this direction to increase further. Manchuria and Korea, which are the centre of soya bean production, differ from China Proper in having greater areas available for field crops; while the ground-nut is adapted to the intensive garden-like methods of cultivation of Southern China.

In the New World, Northern Mexico, outside the tropics, has some importance as a cattle-rearing region, the surplus going to the United States.

Cattle-farming on the extensive, ranching system is followed in the provinces of Chihuahua, Sonora and Coahuila, adjoining the American boundary. The region occupied by these provinces is all well over 2,000 feet in elevation, and enjoys better climatic conditions than the semi-arid Western States of America, owing to the rather more equable climate and less deficient rainfall.² It has been able to supply a large number of young cattle annually for export to the United States ranges as "feeders."³

Northern Mexico, however, suffers from several disadvantages that prevent its developing as a cattle-raising region to the full extent of its resources: the government is weak, and property is consequently insecure; few systematic efforts are made by Mexican cattlemen to improve the poor quality of their stock, and the attempt made by American stock-owners in the country are of little avail, because of the absence of fencing and the mingling of the herds; scarcely any provision is made by way of fodder crops for the six to seven months dry season that occurs annually, so that the condition of the stock is apt to be poor; and little organised effort is made in the direction of contending with the prevalent animal diseases.

Northern Mexico is accordingly not able to export any refrigerated meat, and is not likely to do so in the near future. The exportable surplus of live cattle also is liable to fluctuations, and as long as the present unfavourable conditions are maintained, will not increase greatly either in quantity or in quality. It is possible, however, that, if American stock-raising interests become firmly established in this region under more settled political conditions, the surplus of cattle will increase to larger and more stable

¹ See above, pp. 82, 83.

² See U.S. Dept. Agric. Bureau Animal Industry, *Bulletin*, 41, pp. 5, 6.

³ The numbers have varied considerably. The average for the 12 years, 1901-12, was 151,000 head.

proportions, and relieve in some measure the increasing pressure upon the live-stock resources of the United States.

Mesopotamia is also a region of some promise in the production of live stock. According to Sir William Willcocks,¹ large parts of the country are suitable to live stock, especially sheep, and "live-stock will always be one of the principal exports of the country." The resources of this region remain, of course largely undeveloped, but progress may be made under more settled and intelligent government in the future.

TEMPERATE SURPLUS-PRODUCING REGIONS.

REVIEW AND SUMMARY.

It is now convenient to collect into a general summary and balance together the main facts and conclusions already submitted, with reference to the surplus supplies—present and future—of animal foodstuffs and feedstuffs from the various great subdivisions of Group I., above discussed.

North America has already ceased to be an important source of meat and dairy produce, with the exception of certain pig-products and of cheese. There may be a large increase of supplies from the Canadian North-West in the near future. Still the population of the continent is growing rapidly, the standard of living is high, and there is a tendency for consumption to overtake production, as shown by recent importations of finished animal produce from the Southern Hemisphere. North America contributes heavily to the world's exported supplies of feedstuffs. This is really an indication that the more intensive methods of animal husbandry are not widely practised. The adaptability of the people may lead to a somewhat rapid change towards these methods in the future under the pressure of shortage of animal foodstuffs; and the change in this direction may proceed so far as to create in the more distant future a greater surplus of these products above the local requirements. In this case, however, there would probably be some decline in the quantities of feedstuffs exported. The prospects for the more immediate future do not disclose the probability of any general increase in the exports of finished animal foodstuffs from the North American Continent, but rather the reverse.

Temperate South America is now the most important source of surplus meat supplies, and a very important source of animal feedstuffs. Unless the area under wheat becomes much greater than at present, there is every likelihood that this region will be able to increase its surplus in both the above-mentioned classes of produce. The greatest immediate obstacle to expansion is lack of sufficient means of transport from the interior to the few effective ports. It is doubtful whether such increases in South American

¹ *Geog. Journal*, Jan. 1910, pp. 1-15.

surplus supplies will be sufficient in the near future to make the total surplus of animal foodstuffs, plus feedstuffs, from temperate North and South America combined, much greater than it was in the period 1900-4.

Australasia has developed great importance in exports both of meat and of dairy produce. It is almost certain that, with the growth of population and of better means of transport to the ports, there will be a steady increase in the exportable surplus of both of these classes of produce. Feedstuffs are scarcely exported at all from Australasia, and there is little likelihood of their being so in the future, owing to its marked suitability for animal-rearing and the high freight charges on feedstuffs to Western Europe. Dairy produce may increase more rapidly than meat in export trade. With reference to all animal foodstuffs taken together, however, no great relief in the event of a general world-shortage, is to be expected from Australasia.

Eastern Europe and Siberia have recently been the most considerable source of surplus animal feedstuffs, and are therefore of the greatest importance to the animal-rearing industries of Western Europe. In foodstuffs their chief importance lies in Siberian butter and Russian and Austro-Hungarian eggs. In all these directions there is room for expansion, which depends mainly upon improvements in the means of transport and the adoption of more intelligent methods of farming. The latter, if realised, might well result in an increase in the crop-yields per acre, and thereby check the tendency for the cultivation of food-crops to encroach upon land used directly or indirectly for the maintenance of animals. The proximity of this area of supply to Western Europe is a favourable condition for increased exports of animal produce and feedstuffs in the future. In general, however, changes and developments throughout this region are likely to be slow, so that no great expansion can be expected in the near future, more especially since the European War has had most disorganising effects.

Among the miscellaneous temperate regions, only China is of note with regard to surplus animal produce or feedstuffs. Both poultry products and oil-seeds and oilcakes have already been considerable export items, and under favourable conditions may increase greatly in the future. The remaining regions in this division together have extensive latent stock-producing resources, but will probably require the lapse of many years before they are properly developed so as to produce an important surplus of meat or meat products.

A general review of the situation with reference to supplies from all these regions brings out a number of conclusions: first, that striking changes have been in progress in North America, which indeed threatens to draw off supplies of certain kinds of animal produce from other countries instead providing a surplus of such supplies; second, that the total exported supplies of the world

have increased more slowly since about the year 1906 than before that date ;¹ third, that few large undeveloped areas, suitable for agriculture and of reasonable accessibility, now remain in the temperate regions ; fourth, that the quantities of concentrated animal feedstuffs which have entered into international trade have been enormous, and that these must be considered together with the movements of animal foodstuffs ; and fifth, that the extensive methods of animal-rearing are passing away in favour of the more intensive methods.

So far as the surplus-producing countries are concerned, the present time, in fact, represents a transition stage between the older pastoral, and the newer intensive, system of producing animal foodstuffs. It would appear, however, that the change requires to be hastened, that further technical progress is urgently needed in the whole agricultural industry, and especially in animal husbandry, in order to bring the supplies of animal foodstuffs into line with demand. Throughout the world agricultural resources are still abundant, but a general re-organisation is required so as to utilise these resources to better advantage. It will be seen in the next chapter that the additional resources of the tropical regions may be used increasingly in the future to raise both directly and indirectly the world's output of animal foodstuffs, and make larger supplies of these articles available in the temperate regions, independently of their own resources. In the meantime, any marked shortage of animal foodstuffs in the international market indicates that the technical developments in the direction of more intensive agricultural methods have lagged behind the needs of the times.

¹ The total exports of meat and meat products from the nine principal countries rose from 2,734 million lbs. in 1895 to 3,478 million lbs. in 1905, which gives an average increase of 2·72% per annum ; by 1912 the total was 3,861 million lbs., making an average increase of but 1·57% per annum for the period 1905-12.

CHAPTER V.

TROPICAL REGIONS.

(a) TROPICAL HIGHLANDS.

IT is proposed in this chapter to review in detail the present and the probable future contributions of the tropical regions towards the world's supplies of animal foodstuffs. Owing to essential differences these regions are divided into two main groups, namely, tropical highlands and tropical lowlands, the former of which will be dealt with first.

Among the highlands of tropical Africa, Abyssinia should be noted as being climatically suited to live-stock, and as producing "magnificent long-horned cattle, donkeys, goats and sheep." The climate is warm, temperate, owing to high elevation in a low latitude, and this, combined with a rainfall of not less than 50 inches, makes the conditions ideal for domestic animals. However, the peculiarly isolated position of the country and the complete lack of modern means of communication with the outside world has been an effective bar to production for export, except, perhaps in the form of live animals driven to the neighbouring districts. In any case, the primitive nature of the economy of the whole of this region of tropical Northern Africa east of the Nile, and the conservative, self-contained habits of the people, make overseas trade in animal products at the present time, almost out of the question. European influence, capital and methods will have to be much stronger in the country before any considerable surplus of live animals or animal produce will be raised there, however suitable the natural conditions may be. It is extremely doubtful whether any far-reaching change in this direction will be made during the next two decades.

Tropical Asia in general contains few highlands where the rainfall and other conditions are favourable to the raising of meat-producing animals, except perhaps towards the south-eastern margin. Such animals as are raised are used mainly for draught purposes, especially in India. The exceptions above noted occur in Southern China and in Indo-China which are gradually increasing their importance as cattle-raising regions.¹ The means of transport and the methods of animal husbandry are both backward and hinder extensive development. In addition, the habits of the people and the needs of the population favour crop-cultivation wherever possible. It is doubtful whether this region will rise to a place of any great importance in furnishing supplies of surplus animal foodstuffs, even with the help of foreign capital in the development of live-stock industries.

¹ U.S. Daily Commerce Reports, Jan. 23rd, 1911.

TROPICAL AUSTRALIA.

Considerable areas of land, said to be thoroughly suitable for cattle, exist in various parts of the highlands of tropical Australia.¹ The most important districts seem to be the Kimberley District in Western Australia and the adjoining land in the Northern Territory, a stretch of country in the Northern Territory bordering on Queensland and various parts of Queensland from the Western border to the coastal range.

Cattle-raising in these districts will probably develop considerably and ultimately provide a large surplus for overseas exports of refrigerated meat. Difficulties have hitherto been encountered in the construction of freezing works at such outlet ports as Wyndham and Derby owing to the fear that West Australian consumers might be prejudiced by a heavy withdrawal of cattle for export.² The more rapid development of cattle-raising industries in tropical Australia has doubtless been prevented as much by this fact as by the more fundamental factors of remoteness from centres of population, of the entire lack of railways and of the deep-rooted Australian dislike for anything resembling exploitation by foreign monopolistic undertakings.³ Hence, in spite of the undoubted advantages in climate and pastures,⁴ possessed by these Northern tropical highlands, it may be some considerable time before they develop stock-rearing industries to such an extent as to be an appreciable factor in the world's supplies of their special products.

MATABELELAND, RHODESIA AND BECHUANA LAND.

This extensive tropical highland is, generally speaking, adapted to cattle-raising in the better watered parts and to sheep farming elsewhere,⁵ except in the low-lying river valleys which are too pestilential for ordinary stock to survive. The average elevation is well over 3000 ft., and the rainfall sufficient, especially towards the East. In Southern Rhodesia the pastures are reported to be richer than elsewhere in South Africa, and germ diseases have been successfully fought by means of dipping tanks. Cattle-raising on a large scale has been established by powerful companies which have constructed private railways to supplement the main state-owned lines. Land is being subdivided, and pastoral settle-

¹ Commonwealth Year Book, 1913, p. 282.—“By far the finest specimens of beef-producing cattle are those raised in the tropical districts of the Commonwealth, *i.e.*, in the northern parts of Queensland, in the Northern Territory, and in the north of Western Australia.”

² Dominions Commission (Cd. 7172), Q. 9042.

³ In this case in the form of freezing works, established by the American Beef Trust.

⁴ See Dominions Commission (Cd. 7172), Q. 9042.—“There are millions of acres of splendid country now lying idle in East and West Kimberley, the Northern Territory, and North Queensland, which could be utilised to grow cattle, sheep and horses. . . . The possibilities of the far North of Australia are enormous; there we have the great essentials in the rearing of stock, a regular and good rainfall and a generous soil.”

⁵ U.S. Daily Commerce Reports, Nov. 2nd, 1912, p. 599.

ment is progressing rapidly, with the result that the number of cattle has increased greatly,¹ while at the same time there has been an improvement in quality owing to greater care in breeding. Sheep-raising does not seem yet to have advanced beyond the wool-producing stage.

Since these cattle districts in tropical South Africa lie some distance from the coast and transport is costly, there is no likelihood at present of refrigerated beef being exported from them overseas, though as previously noted, some supplies may reach the mining centres to the South, and so relieve the necessity for imports into South Africa or even set free a part of the southern output for export. Till the present time, surplus cattle from Rhodesia and the neighbouring tropical highlands have been converted into beef extracts for which there is a growing demand throughout the world. Owing to the great portability of these products, their manufacture is an industry well suited to places distant from the sea coast. Any increase in the South African output would tend to relieve the drain upon South American cattle for this purpose and thereby indirectly to set free a greater number there for refrigeration.

Provided cattle diseases can be successfully combated in these South African highlands, it seems quite probable that considerable developments in stock-raising for external market supplies will take place.² "Southern Rhodesia promises to be a great cattle-breeding region, in spite of occasional outbreaks of germ diseases."³

The equatorial highlands of British East Africa have recently become important in wool-bearing sheep, which are now said to number about 7 million.⁴ Even if no supplies of mutton are derived in the future from this source, it should be noted that the world's demand for wool as well as for mutton is constantly increasing, and that breeding for wool is unfavourable to the maximum output of mutton. Accordingly regions such as British East Africa and the interior of Australia that specialise in wool-producing sheep may, as above observed, indirectly play an important part in the production of the world's supplies of meat.

The island of Madagascar, which lies largely within the tropics, has recently developed considerable stock-rearing industries.⁵

¹ U.S. Daily Commerce Reports, Oct. 28th, 1914, p. 483; Sept. 16th, 1911, p. 1254; June 16th, 1911, p. 1195.

² Considerable increases took place in the numbers of live stock in Southern Rhodesia in the period 1911-1914; in cattle the increase was 61%; in sheep 11%, and in goats 12%.—U.S. Daily Commerce Reports, Sept. 14th, 1916, Supplement 66a.

³ Sir Harry Johnston.

⁴ According to a recent American Report the number of sheep in British East Africa increased from 4.3 millions in 1908 to 7 millions in 1912.

⁵ According to an American Report, cattle in Madagascar increased from 2 millions in 1898 to 5.5 millions in 1912.

See also *Annales de Géographie*, March, 1916, pp. 92, 93, where it is estimated that the exportable surplus of cattle may in the future approach 200,000 head annually.

Attention is given mainly to cattle, but pigs and sheep are also raised. The mountainous nature of the island and the abundant rainfall contribute to the existence of rich highland pastures favourable to the rearing of sheep and cattle, while the tropical and sub-tropical crops of the lowlands provide abundant material for the fattening of lard-producing pigs. Recent statistics show that the island is increasing its exported surplus of animal foodstuffs, the most important items being salted, preserved and refrigerated meats, lard, and live animals. Several freezing works have already been established at various points on the coast, and it seems probable that in the future there will be further marked increases in the quantities of meat and meat products exported.¹

TROPICAL HIGHLANDS IN THE NEW WORLD.

In Mexico and Central America there are extensive plateaus and mountain highlands where the climatic conditions are fairly suitable for cattle and sheep. The plateau of Mexico, south of the tropic of Cancer, includes the most densely populated part of the whole country, and cereal cultivation is, naturally, the principal form of agriculture. Since, however, in ordinary years Mexico is unable to supply its own needs in cereals from its own resources, it is not likely that the existing animal-rearing industries will be much extended in the future even with the possible introduction of more modern methods of cultivation and animal husbandry. From an agricultural point of view the wealth of Southern Mexico lies in tropical produce, raised on the slopes of the plateau and on the lowlands, but these parts of the country are naturally quite unsuitable for stock-raising.

The States of Central America also contain certain highlands with well-watered valleys suitable for cattle rearing. The total number of cattle in these states is about 1.6 millions,² while the population is relatively sparse, except in the small State of Salvador. According to an American Report³ there are considerable numbers of cattle in Southern Honduras in the provinces of Choluteca and Olancho bordering on Nicaragua. This district, occupying the middle part of the Central American region, may perhaps be taken as typical, at any rate of the Pacific Slope, where the rainfall and climate are less tropical than elsewhere. Here the "soil, grass and climate are well adapted to stock-raising." The possible surplus for export from Honduras alone is estimated at about 30,000 head per annum. Hitherto, however, little progress in stock-raising for export has been made owing to characteristic causes. No provision is made for carrying stock in good condition

¹ The exports of meat from Madagascar rose from 23,000 lbs. in 1903 to over half a million lbs. in 1909, and to 5 million lbs. in 1911.—U.S. Dept. Agric., Bureau Crop Estimates Report, 109.

² According to the figures given in the U.S. Year Book of Agriculture, 1914, p. 613.

³ Animal Industry Rept., 1910, pp. 285 *et seq.*

over the annual dry season ; forests still occupy much of the ground ; animal diseases are common, and no steps are taken to check or extinguish them ; means of communication in roads and railways are almost entirely wanting ; and the people are unenterprising and lack the instinct for careful, scientific methods in animal husbandry. There is some possibility, however, owing to the political and commercial influence of the United States, combined with the threatened meat shortage in North America, that American capital will be found to develop these states, and perhaps also to take up cattle-raising and meat export on a large scale. The climate does not seem to be favourable to sheep, and pigs, though kept, are much neglected. In the matter of cattle there seems to be a distinct probability that a comparatively small, though increasing, supply of lower-grade animals will be available for export, either as live or as refrigerated meat, from the Central American States, within the next decade or two.

COLUMBIA AND VENEZUELA.

These two countries, though both lying for the greater part within 10 degrees of the Equator, are said by various authorities to be suitable for sheep, and especially for cattle rearing on a large scale. In both of them the well-watered highland valleys and the "llanos" sloping towards the Caribbean and the Atlantic are covered with natural grasses, suitable for stock, but apt to become withered in the dry season, especially in the valley of the Orinoco.¹ The rainfall is, in general, heavy, but is badly distributed throughout the year. Hitherto, however, little serious attention has been given to stock-rearing in the countries, which contain a mere handful of animals compared with their carrying capacity. In Venezuela the numbers of cattle were, it is said, reduced from 8½ millions in 1885 to 2 millions in 1898, owing mainly to civil wars.² Some exports of beef have been made from Porto Cabello in Venezuela, but the quality has apparently been inferior.³ Many of the existing much-reduced herds are said to be in a half-wild state. Nevertheless both countries are held to have considerable future possibilities in stock-rearing for a meat export trade.⁴

¹ International Agricultural Institute, *Bulletin of Social and Economic Intelligence*, Aug., 1915, p. 124—(in Columbia) "there is a considerable area of land suited to stock-breeding, situated along the valleys of the great rivers, the slopes of the tablelands and the vast south-eastern plain."

² L. V. Dalton, "Venezuela," 1912, p. 247.

³ The exports of meat from Venezuela have ceased for the present, but some live cattle are exported.

⁴ "Cattle-breeding should be a great and important industry for Venezuela, and it is to be hoped that it will be put on a better footing before long."—L. V. Dalton, "Venezuela," 1912, p. 197.

Again, "There is therefore good reason for the belief that Columbia will soon be the field of large and extensive development along this line" (of cattle-rearing).—U.S. Daily Commerce Report, May 6th, 1914, p. 696.

In Columbia "this (the cattle-rearing) industry is likely to gain ground from day to day, thanks to scientific selection of breeding stock and the more

In order that these possibilities may be realised it is necessary that some change should be made in the present methods of stock-raising. Capital is required for the construction of means of communication and of freezing-works at suitable ports. At the present time cattle intended for export trade have to be driven such distances in Venezuela that they lose condition. The construction of irrigation works is also of pressing importance in view of the annual dry season.¹ From the simple geographical point of view there seems no reason why these countries should not produce in the future large surplus supplies of cattle. The main obstacle to development at the present time seems to be the low density of population and the consequent labour shortage.

Should a meat scarcity continue to be felt in the world's markets, it is possible that in both these countries, as well as in other undeveloped parts of the New World, syndicates working with foreign capital may establish large-scale undertakings not only in meat-packing and refrigerating plants, but also in stock-rearing. What these countries require is the example of systematic and scientific methods in the development of their pastoral resources.

The extensive highlands of Eastern and Central Brazil contain, especially towards the interior, large areas of native pastures. The rainfall is, generally speaking, sufficient, but is unequally distributed throughout the year. On the eastern coastal slope it is excessive, and is more favourable to forests than to pastures. As a stock-raising region the tropical highlands of Brazil are faced with the difficulties of communication between the coastal ports and the interior, over the intervening forest and mountainous belt. Cattle are numerous in the middle highlands of the latitude of Matto Grosso and goats towards the North-East. The breeds and the quality of these animals, however, are distinctly inferior, so that, until recently, tropical Brazil has been unable to furnish its own requirements in meat and dairy produce, even with the assistance of the southern temperate highlands, already described.

Nevertheless, in recent years a change has been in progress. Brazil was formerly a large, and the most important market for the Argentine and Uruguayan exports of jerked beef, but the latter countries have more or less dropped out of this trade since freezing

thorough utilisation of natural meadow lands."—International Agric. Inst., *Bulletin*, above quoted.

In Columbia, on the Meta Savannah, "there are about 5 million head of live stock; but competent authorities believe that by developing the cultivation of grass-lands and by irrigation, over 30 million head of cattle could be raised in this region."—International Agric. Inst., *Bulletin*, above quoted, p. 124.

¹ "Undoubtedly when a better system of irrigation has improved the pasture lands of Columbia, and when means of communication for the transportation of live stock and frozen meat are provided, the export trade in these products will become of great importance to the country."—International Agric. Inst., *Bulletin*, above quoted.

works have been established on the La Plata estuary. Paraguay still supplies the Brazilian market with this product to the extent of its surplus. The general prosperity of Brazil has also assisted in encouraging the raising of cattle in the country to supply local markets with jerked and fresh meat.¹

The chief pastoral provinces in tropical Brazil are Matto Grosso and Goyaz in the interior, whence cattle are driven great distances to the coastal markets; Minas Geraes, which is the chief dairy province, and Sao Paulo, also have large numbers of cattle. Except in Sao Paulo, all kinds of stock-raising are carried on in a most primitive way, and the products are far from export standard. The Brazilian government, as before noted, is actively encouraging the improvement of live-stock, and it is possible that great advances will be made, since the pastoral resources of the country are most abundant, but not rich.² Excellent rough grazing lands appear to exist in almost unlimited quantities on these highlands.

There is no essential reason why tropical Brazil should not produce a much greater quantity of finished stock, particularly of cattle than it does, nor why the stock should not be of a much better quality. There are indications that Brazil may shortly become an important beef-exporting country, since British and American cattle and meat companies³ have already established themselves in the country with a view to producing and exporting refrigerated beef.⁴

What tropical Brazil requires in order to become a great meat-exporting country is, first, increased and improved means of communication, then attention directed to improvements in pastures and to the care of stock, and finally the organisation of the whole industry on modern lines as in Argentina. It is possible that exports of mutton may be added to those of beef when the latter are properly organised.

The population of tropical Brazil is small in proportion to its area, and the country is so rich in vegetable food-products that it will be a long time before the "vast areas" of pastoral country are encroached upon by advancing population for closer settlement. Brazil has already begun to be an exporter of refrigerated beef, and possibly before long may figure as one of the more considerable sources of surplus supplies of meat for the outside world.

¹ The imports of meat into Brazil, which amounted to 123 million lbs. in 1903, fell to 80 million lbs. in 1910, and to 57 million lbs. in 1912.

² "The pasture lands of Brazil . . . need to be improved by the judicious selection of native plants for fodder and by the acclimatisation of good foreign species."—Brazilian Commission for Economic Expansion, Vol. II. p. 177.

Alfalfa is not yet much cultivated, but is said to have a great future.—Brazil in 1911, Chap. xviii., also work above quoted, p. 177.

³ See U.S. Daily Commerce Reports, Oct. 5th, 1915, and Aug. 30th, 1916, Supplement 40 c.

⁴ Concerning the rise of the meat export trade of Brazil since the year 1914, see Chap. iv., above, p. 66, Note 1.

TROPICAL HIGHLANDS—SUMMARY.

The characteristic feature of practically all tropical highlands is their need for development. Since the time of the introduction of transport under refrigeration, it is only in the last few years that a shortage in the world's supplies of animal foodstuffs has begun to be felt. Till recently there was an abundance of land available for production, and the tropical highlands, owing to the peculiar initial difficulties, have thus been more or less neglected. It is possible, however, that when once the best of these are made productive and are brought, through proper means of transport, within effective reach of the world's markets, they will be found rich in pastoral resources. Owing to the mountainous nature of these tropical highlands, they will always be more adapted to pastoral industries than to crop cultivation, so that the latter will not interfere much with the former, as it tends to do in rich prairie regions.

At the present time and for the immediate future the greatest possibilities for development in the tropical highlands lie in the direction, first, of cattle-rearing, and next of sheep-rearing, the characteristic heavy seasonal rainfall being more favourable to the former. However, the total number of meat-producing cattle in all these regions, taken together, cannot at present be more than 40 millions¹ of average low-grade quality, and about one half are in Brazil where local consumption makes at present heavy demands upon the available product.

Owing to the fact that these tropical highland cattle are mostly inferior stock, and are left very much to "shift for themselves," it is probable that their average meat-producing capacity is not more than half that of high-grade Western European stock. Hence the total exports of live animals, beef and meat products from tropical highlands is small, even though the population is generally sparse. A greater density of agricultural population in these regions up to a certain limit would lead to an increase in the quantity and the quality of the exportable surplus. Sheep-rearing has so far received little attention in most of these undeveloped highlands, so that neither wool nor mutton has been exported from them. The value of these tropical highland areas from the point of view of this enquiry lies much more in their potential rather than in their actual production of meat and meat products. Something has already been done, as above noticed, towards building up large-scale meat-exporting industries in Rhodesia, Madagascar, Brazil and Venezuela, but these industries are as yet only in their initial stages. These regions all require the fertilising agency of capital in order to make their latent pastoral resources contribute an important share of meat to the world's supplies. To what

¹ Distributed as follows:—Brazil (tropical) upwards of 20 mill., Columbia and Venezuela about 9 mill., South Africa about 1 mill., Madagascar 5 mill., Tropical Australia about 1 mill., other tropical highlands (mainly in the Northern Hemisphere) about 4 mill.

extent capital will be applied to their development depends upon, first, the amount of capital seeking investment in such special forms, and this may for some time be limited ; second, the course of meat prices, which is more likely to be upward than downward, as compared with the pre-war level ; third, the facilities offered by the various governments to capitalistic enterprise ; and fourth, the progress made in the near future by veterinary science in overcoming the destructive effects of animal diseases.

It is noteworthy that in most of these highlands containing large areas of undeveloped pastoral land, the most promising form of stock-raising for export is that conducted by large syndicates, financially strong enough to furnish the equipment, the improved stock, and the other means of establishing the whole business on the most modern lines.

(b) TROPICAL LOWLANDS.

For practical purposes in this enquiry, the term tropical lowlands is taken to include all such areas within the tropics as are not rendered distinctly temperate in climate by considerable elevation. The interest of these areas lies in their indirect contributions to the world's supplies of animal foodstuffs in the form of oil seeds and nuts.¹ The utilisation of such materials for the manufacture of butter substitutes and of feedstuffs has already been referred to, and is daily growing in importance.²

It should be noted that cotton-seed, from which both oil and oil-cake are produced, and which has therefore a similar indirect value in relation to the supplies of animal foodstuffs as tropical oil-seeds have, is almost entirely of warm temperate origin, and falls, therefore, into the latter class only to a very limited extent. Cotton, indeed, is rather a competitor with food-producing animals for the utilisation of land in the temperate regions than an external aid, in the sense that tropical oil-seeds are.

¹ The most important of these are palm kernels and copra, to which sesame seed, a cultivated crop may perhaps be added. Besides these, there are two others, namely, the ground-nut and the soya bean, which are capable of extensive cultivation in warm temperate regions and in tropical highlands. The former is now grown as a catch-crop in Southern India, but it can be grown successfully in any warm, temperate climate. The labour difficulty appears to be the chief obstacle to its wider cultivation ; other obstacles lie in the facts that it is not sufficiently known and that markets are not properly organised. The soya bean is cultivated at present mainly in Manchuria, but the climatic conditions are highly favourable in South Africa, in the Southern United States, and elsewhere. The chief obstacle to the more extensive cultivation of this plant for seed production, in regions outside Manchuria, is the difficulty in obtaining labour for harvesting. The soya bean is grown as a fodder and hay crop in the United States, its feed value being as high as that of lucerne.

² In the year 1912-13 it is estimated that the various producing regions together exported about 600,000 tons of copra and over 328,000 tons of palm kernels. Prior to the year 1900 these materials entered little into international trade.

The rapid strides made by the oil-crushing and extracting industries of Western Europe during the years 1900-14 were remarkable, and give promise of great developments in the future. These industries have received stimulus, first, from the increasing market for margarine in recent years,¹ and second, from the fact that it has been found that the cake and meal residues have feeding-values as high as those of the better known linseed and cotton-seed cakes.²

The supplies of palm-kernels and coco-nuts seem practically unlimited. Hitherto in most of the producing regions, very little effort has been made to plant or cultivate the trees, so that the cost price represents the cost of collection together with transport charges only. With the construction of railways and other means of transport, and the development of concessions under European control and management in West Africa and elsewhere, it is likely that the world's supplies of tropical oil-bearing seeds and nuts will increase considerably in the future.

These developments will have marked effects upon industries devoted to the production of animal foodstuffs. With further technical improvements in the manufacture of margarine on a large scale, this product may even become a serious competitor with butter.³

Commercial oils used in soap-making and other similar industries will be available in greater quantities, so that fats of animal origin can be largely dispensed with for such purposes. The cattle and pig-raising industries of the more densely peopled countries of the Northern temperate zone will have enormous supplies of cheaper oil-cakes and meals of high nutrient value available for stock consumption. The fertility of the land in these countries will be indirectly increased by feeding stock with these concentrated materials of tropical origin; and as the world-problem at the present time is to utilise the seemingly inexhaustible fertility of the tropics rather than to draw further upon the limited stores of fertility in the temperate zone, this in itself is of no small importance.

Since the establishment of lines of cheap sea transport for bulk cargoes all over the world, it has become theoretically possible to organise production of foodstuffs according to regional capacity, irrespective of the concentration of population. Though this has been done very imperfectly hitherto, any assistance from tropical sources is of great value in increasing the production of animal foodstuffs, in view of the strain now thrown upon the producing areas of temperate latitude. Since the tree-vegetation of the tropics exhausts soil fertility much less than the annual crops of temperate regions, since also the fertility of tropical lands is

¹ See below, Part II., Chap. ii., pp. 209, 210.

² See Report of Committee on Edible Oil-producing Nuts and Seeds (Cd. 8247), also Journal of Board of Agriculture, Sept., 1917, p. 663.

³ See Messrs. Weddel & Co.'s remarks in their Annual Review of the Dairy Trade, 1913, pp. 13, 14.

enormous and the population, except in Monsoon Asia, generally sparse, it may be concluded that the possible production of oil-bearing nuts and seeds from them is for the present capable of enormous increase.¹ Domestic animals cannot be successfully reared in the tropical lowlands; but cheap transport enables these oil-bearing vegetable products to be carried to countries where the climatic and other conditions are eminently suited to the rearing of food-producing animals, and there be fed to them.

A general review of the contributions, present and future, of the tropical regions of Group II. shows that in recent years a beginning has been made in both tropical highlands and in tropical lowlands, in utilising their resources directly or indirectly for the increased production of animal foodstuffs throughout the world. At present the output of meat products from cattle and sheep raised on the pastures of tropical highlands is of much less moment in the world's supplies of animal foodstuffs than are the exports of oil-bearing nuts and seeds from tropical lowlands. In view of a growing shortage of animal fats for human consumption, the edible oils alone of tropical origin already play an important part; and the oil-cakes and meals from the same sources are daily growing in significance with the relative decline in the areas of land in temperate regions available for the production of fodders and feedstuffs.

In the near future great developments are likely to take place both in the stock-raising industries of tropical highlands and in the production of oil-seeds from tropical lowlands. Better means of transport and cheap freights are essential to progress in both directions; but such progress also waits on certain technical and scientific developments of a special kind, which require the application of advanced scientific knowledge in dealing with the animals, with stock diseases, and with the pastures. Moreover, the satisfactory handling of perishable products in these regions requires the best technical equipment. In the trade in oil-seeds it is clear that every improvement in the care and cultivation of natural forests and plantations, in the methods of collecting, preparing and transporting the seeds, and, above all, in the methods of crushing and extracting and of refining the products, add to the possibilities of expansion. This group of industries is comparatively new and has hitherto had to fight its way against established products—butter, animal fats and feedstuffs—of temperate origin, but the indications certainly point to a weakening of such competition in the future. Should great developments in the production of edible oils from tropical oil-seeds take place, the result would be to throw large quantities of feed-cakes and meals upon

¹ It appears that other tropical regions, besides those already under exploitation produce oil-bearing nuts and seeds, notably Central and South America, but the shortage of labour is a hindrance.—Report of Committee on Edible Oil-producing Nuts and Seeds (Cd. 8247), p. 12.

the markets of the densely-populated countries bordering the North Atlantic, and this would render possible some increase in the intensive methods of animal husbandry as practised in those countries.

NOTE TO CHAP. V.

The surplus production of rice and other starchy foods in tropical lowlands also has some bearing upon the subject-matter of this chapter. The agricultural resources of the temperate regions are obviously supplemented by any importations into them of milled or unmilled rice or of rice offals from the tropics. The milled grain reduces correspondingly the quantities of cereals or of potatoes that require to be grown for human food in the former, and the same applies to such materials as sago and tapioca ; while rice offals form a substitute for concentrated feedstuffs of temperate origin. For a discussion of the production of food crops in relation to animal industries, see Chap. xi. below, where also reference is made to the production of sugar in the tropical regions.

CHAPTER VI.

THE ELABORATING COMMERCIAL COUNTRIES.

IN a number of areas, as has been observed, animal industries are conducted on a more or less intensive basis, as distinguished from the pastoral system, by using feedstuffs imported from abroad or brought from other parts of the same country. Such areas are found mainly in Western Europe, but also to some extent in Eastern North America. Important industrial countries such as Great Britain, France, Germany and Belgium are among such areas; these export agricultural products to a quite limited extent, and, with the exception of France, they have scarcely any export trade in animal foodstuffs; their imports of foodstuffs, and especially of animal foodstuffs, are in general much greater than the corresponding exports. On the other hand, certain countries, among which Denmark, Holland, Sweden and Ireland are the chief, have much greater exports of animal foodstuffs than imports. In the case of these countries, concentrated feedstuffs and cereals for human consumption are imported, as shown above, as a means of increasing the exports of finished animal foodstuffs, the elaboration of which is in most of them the principal industry. It is proposed in this chapter to discuss in detail the conditions of production in these countries, and incidentally to touch upon any noteworthy facts relating to internal consumption.

(a) DENMARK.

Considering its somewhat meagre resources in soil and climate for animal industries, Denmark presents what is probably the most remarkable example of the elaborating-commercial type in the world. On a productive area of a little over 9 million acres—less than half the productive area of Ireland—Denmark supports a population of $2\frac{3}{4}$ millions, and in addition exports more butter than any other single country, more pig-meat than any other country except the United States, and a considerable number of cattle. The explanation lies, first, in the high proportion of arable to the productive area (over 70%), and second, to the extensive importations of feedstuffs and of fertilisers as raw materials, and of wheat and rye for human food. A detailed examination of the trade figures for the year 1912 shows that the total net *exports* from Denmark of the principal items of animal foodstuffs amounted in value to £23·2 millions; for, while there were in the same year net *imports* of cereals and feedstuffs, together amounting in value to £10·4 millions, of which the materials fed to food-animals would

represent a sum approaching £7 millions in value. If this be deducted from the total value of the net exports of animal foodstuffs, the balance then becomes rather more than £16 millions. It may be said, therefore, that the people of Denmark in the year 1912, when they had provided for their own requirements in animal foodstuffs and had paid for their imports of feedstuffs, had a net balance in hand of about £16 millions as a result of the year's working in animal industries.

As in the case of Holland, the exports of animal foodstuffs from Denmark depend upon the maintenance of the imports of raw materials in the form of feedstuffs and fertilisers, since these supply what the country cannot well furnish from its own resources. A cold temperate country such as Denmark produces fodder crops admirably, but for the more intensive branches of animal industries, such fodder crops require to be supplemented by concentrated feedstuffs, of which only barley is readily produced within the country. In former times Denmark was much more markedly a cereal producing and exporting country, but the fertility of the soil was threatened,¹ and the facilities for importing food cereals and feedstuffs have made possible the expansion in specialised animal industries on the great scale of recent years.

Since 1893 there has been a considerable increase in the ratios of food-producing animals (sheep excepted) to the population, as shown in the following table:—

TABLE SHOWING THE NUMBERS OF CATTLE, SHEEP AND PIGS AND OF "CATTLE UNITS" PER 100 OF THE POPULATION OF DENMARK IN RECENT YEARS.

	CATTLE	SHEEP	PIGS	"CATTLE UNITS"
1893	77	56	37	133
1909	83	27	54	155
1914	86	18	87	198

Not only was there a substantial increase in the ratio of food-producing animals combined, to the population in the 21 years covered by the above table, but this ratio was high as compared with other European countries. This increase has rendered possible an expansion in the exports of animal foodstuffs in recent years.² Owing to the same cause there has been some decline in

¹ See U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin* 129, p. 7.

² Between 1901 and 1911 the number of cattle exported from Denmark increased by 271%, and the quantities of butter, eggs, and meat and fats respectively by 34%, 13% and 90%.

With regard to dairy produce there has been a great increase in the milk-yield per cow, which has been a powerful contributing cause in the increased exports. The average animal yield rose from 2,200 lbs. in 1866 to 6,600 lb. (estimated) in 1911.—(U.S. Dept. Agric., Bureau An. Ind., *Bulletin* 129.)

the imports of animal foodstuffs, those of meat and meat products for example, fell from 133 million lbs. in 1907 to 33 million lbs. in 1912.²

The home consumption of animal foodstuffs in Denmark accounts for a considerable part of the total production—probably more than half. The per capita meat consumption appears to be comparatively small, having been estimated at 76 lbs for 1902, but the per capita consumption of dairy produce, including margarine, is very high; the butter consumption has been estimated at 20 lbs. per capita, and that of margarine at about 12 lbs., while the whole milk consumption has been set down at no less than 40 gallons per capita, as compared with 23 gallons in the United Kingdom. The per capital consumption of poultry and eggs is probably considerable also, owing to the extensive production of these articles in the country. The figures given above are the estimates for the year 1902, and since that time there has in all likelihood been some general increase consequent upon the rising prosperity of the country.

With regard to future surplus production, its extent depends upon the ease with which supplies of animal feedstuffs can be imported from other countries. It is interesting to note in this connection that the per capita production of barley, the only kind of concentrated feedstuffs produced to any extent within the country, has fallen slowly since the year 1900. The agricultural population is dense and the system of animal husbandry represents almost a maximum of intensification under the existing conditions. On the other hand, manufacturing industries are neither very considerable, nor are they likely to expand rapidly owing to the comparative absence of raw materials and the lack of coal. No great increase in the population is therefore likely; moreover, it is probable that the natural increase will be checked somewhat by emigration in the future, as has been the case in the past. Since the country depends for its prosperity almost entirely upon exports of animal foodstuffs, and since animal industries are more highly developed in Denmark than in any other country, it seems probable that it will provide a considerable, and, under favourable conditions, possibly an increasing surplus of animal foodstuffs for export to neighbouring countries.

(b) HOLLAND.

Holland belongs also essentially to the elaborating-commercial group of countries with regard to its agricultural industries. As compared with Denmark, however, the population is much greater and manufacturing industries and commerce are more extensively developed. In view of its comparatively small area and of the

¹ This remarkable decline is due probably in the main to the substitution of vegetable oils for animal fats in the manufacture of margarine for home-consumption. A large part of the Danish imports of meat and meat products consists of animal fats and oils.

dense population to be supported, the numbers of food-producing animals in Holland and the exports of animal foodstuffs are striking. Not only are the per capita ratios of such animals high, but they have increased on the whole since 1890, as shown in the following table :—

TABLE SHOWING THE RATIOS OF CATTLE, MILCH COWS, SHEEP, AND PIGS, AND OF CATTLE " UNITS " PER 100 OF THE POPULATION OF HOLLAND IN DIFFERENT YEARS.

	ALL CATTLE	MILCH COWS	SHEEP	PIGS	" CATTLE UNITS "
1890	34	20	18	13	53
1910	34	18	15	21	63·8
1913	33·3	—	13·4	21·4	62·4

When the increase in the ratio of " cattle units " to the population (shown in the last column above), is considered, it is not surprising to find that there has been an increase in the exports of animal foodstuffs in recent times,¹ even in spite of the fact that the per capita consumption of these foodstuffs, including margarine, has increased in common with the neighbouring countries of Western Europe. With reference to the various classes of live-stock, the above table also shows that in recent years in Holland cattle have remained nearly stationary relative to the population, that dairy cattle have declined somewhat, but have probably increased their milk per head of the population, and that sheep, as elsewhere, have steadily declined in favour of pigs.

An examination of the figures of import and export trade for Holland reveals the complexity of the country's trade in the matter of foodstuffs and feedstuffs. As is well known, margarine constitutes one of the more important items of animal foodstuffs exported. The value of the margarine exports in 1912 was estimated at about £5 million, but, on the other hand, there were in the same year large imports of animal fats and oils valued at more than £3 million, in addition to vegetable oils. These animal fats and oils were used partly in the manufacture of margarine, and partly as such to supply the local deficiency. The imports of oil-seeds in the same year were valued at over £3½ million, and these were used after crushing as regards the oils mainly for margarine

¹ The increase in the Dutch exports of animal foodstuffs in recent years is well illustrated by a comparison of the quantities exported in 1912 with those exported in 1901 as shown below.

	LIVE ANIMALS	BUTTER MILL. kg.	CHEESE MILL. kg.	MARGARINE MILL. kg.
1901	116,144	22·1	47·3	68·3
1912	524,713	39·15	59·5	86·5

manufacture, and as regards the cakes and meals, as feedstuffs for animals; so far as these cakes and meals were fed to dairy cattle, the imports of oil-seeds reappeared in part as exports of butter and cheese. In the same year Holland imported cereals and feedstuffs of different kinds (excluding rice) to the value of about £21 million in excess of exports; an important part of this excess was accounted for by maize and barley, which are essentially animal feedstuffs.¹ Thus when animal foodstuffs alone are considered, Holland exported in the year 1912 an excess value over imports of about £7½ million; but when the values of the excess imports of cereals and feedstuffs are included, there was a considerable deficit on the agricultural business of the country, this deficit, however, being more than accounted for by the local consumption of the 6 odd millions of the population.

The per capita consumption of meat has been estimated at 70 lbs., of butter at 13 lbs., and of cheese at 11 lbs. The meat consumption is moderate, the butter consumption somewhat low, owing probably to the large supplies of margarine available, and the cheese consumption higher than that for any other country for which figures are available. It appears, therefore, that the consumption of dairy products, including margarine, is greater per capita than for most European countries, while that of meat is under the average. There is little likelihood of a marked increase in the per capita consumption of animal foodstuffs, and particularly of meat. It should be noted that the poultry industry has increased greatly in importance in recent years; while formerly there were net imports of eggs, there have more recently been considerable net exports. It is probable, therefore, that the local consumption of poultry and eggs has increased per capita in the last two decades.

Holland is a country of rich pastures, and the methods of agriculture and of stock-raising are highly intensive. As in parts of Germany and of Denmark, sugar beet are cultivated in conjunction with stock-rearing, so that the country has net exports of sugar in addition to those of animal foodstuffs. There has been a general increase in the productiveness of live stock, especially of dairy cattle, in recent years, and this may well continue in the future, provided it remains possible to obtain the necessary supplies of raw materials in the form of feedstuffs from overseas. These supplies are the basis of the export trade in animal foodstuffs in countries such as Holland; if they, or the supplies of cereals for human consumption from foreign sources, fail to any extent, the exports of animal foodstuffs will dwindle and may disappear.

¹ Part of the barley and other grains imported was used in the distilleries which are established on a large scale. The refuse from distilleries has small value as feedstuffs. Some deduction should be made from the imports of cereals, therefore, in attempting to construct a balance sheet of the trade in foodstuffs and feedstuffs.

(c) SWEDEN.

From the point of view here taken, the only important part of Sweden is the Southern Peninsula, comprising the old provinces of Svealand and Gothland, and lying almost entirely south of parallel 60° N. The agricultural and animal-rearing industries of the country are largely concentrated in this southern section. The northern and larger half of Sweden is of interest mainly in connection with consumption. The population here, which is engaged more particularly in mining and in the timber industry, is to some extent of a migratory character. The small quantities of rye and barley grown in the northern section and the equally small numbers of cattle and sheep raised are probably quite insufficient to supply the needs of the population either in cereals or in animal foodstuffs. The southern part of Sweden, on the other hand, resembles the neighbouring area of Denmark in its agricultural system. Both regions have specialised in dairying; they both import large quantities of cereals for human food, thus reserving a larger proportion of their available agricultural resources for the maintenance of food-producing animals, and they both supplement the local production of fodders and feedstuffs by importations of concentrated feedstuffs from abroad.

The chief difference between Sweden and Denmark in this connection lies in the much greater extent of manufacturing industries in the former, due to resources in timber, metals and water power, which are not found in Denmark. The home market is, therefore, much more important to Swedish agricultural producers than it is to Danish.

The net imports into Sweden in 1912 of the principal items among the food cereals taken together amounted to over £2 million, while the estimated net imports of feedstuffs directly or indirectly available for food-producing animals similarly amounted to over half a million pounds in value.¹ The following table shows the imports and exports of articles connected directly with animal industries :—

IMPORTS		EXPORTS	
	£ mill.		£ mill.
Net imports of feed-stuffs (estimated)	·537	Cattle	·66
Oils and fats	·53	Swine	·01
Bacon and Beans ...	·1	Dairy produce	2·56
	<hr/>		<hr/>
	1·17		3·23

In the business of animal industries there was thus a balance of over £2 million excess exports, when allowance has been made for the net imports of feedstuffs. When, however, the net imports of

¹ This figure is obtained by the method of taking co-efficients for different cereals, etc.—See p. 33, above.

cereals for foodstuffs are deducted (in value about £1·8 million) this balance nearly disappears.

Sweden, taken as a whole, is therefore much less a surplus area in the matter of foodstuffs than Denmark. The causes are obvious ; the population is about twice as great, while the area of fertile agricultural land, though larger than that of Denmark, is limited ; the climate on the whole, even in the southern section, is more continental in type, and therefore less favourable to the growth of grasses and fodder crops for beef and dairy cattle ; the system of animal husbandry is less highly developed and much less intensive, as is shown by the comparatively small imports of feedstuffs ; and finally, a larger share of the best energies of the people is devoted to manufacturing and other non-agricultural occupations.

The changes in recent years in the ratios of food-producing animals to the population are of interest in considering the probable relations between production and consumption in the future. The following table shows the changes in the ratios between two selected years, per 100 of the population.

	CATTLE	SHEEP	PIGS	" CATTLE UNITS "
1890	50	28	13	71
1911	48	17	17	72

It will be seen that in the 21 years covered by this table the per capita ratios of pigs and " cattle units " increased somewhat, while that of sheep, as in the rest of Western Europe, declined considerably. The increase in live stock per capita of the population was reflected in the rise in the net exports of animal foodstuffs. Thus the net exports of the principal items of such foodstuffs, taken together (inclusive of live cattle and pigs) rose from a value of about £2 million in 1901 to that of over £3 million in 1912.

With regard to the per capita consumption of animal foodstuffs in Sweden, the figures available are those for the year 1902. The meat consumption in that year was estimated at 62 lbs. per capita, that is, a little more than one half that of the United Kingdom ; the butter consumption was estimated at 15·8 lbs. per capita and the cheese consumption at 4·6 lbs. per capita, both of which are moderate compared with other European countries. These comparatively low figures do not necessarily imply a low standard of living among the people, since the per capita fish consumption is unusually high ; but, on the whole, the population does not appear to have been liberally nourished, and there was room for improvement. The figures of the per capita consumption of animal foodstuffs probably rose subsequent to 1902, and may do so still further in the future, if the prosperity of the country continues. On the other hand, the population has increased rather slowly owing to

losses by emigration; the agricultural population has actually declined in recent years owing to the attraction of other industries. It is probable that emigration, especially of agricultural workers, will be resumed after the close of the war, and no great increase in the population in the near future is to be anticipated.

The surplus of animal foodstuffs from Sweden has not been very great in the past, and, though it has expanded noticeably in recent years, is not likely to increase rapidly in the future, without greatly increased imports of concentrated feedstuffs. There has, however, been a considerable development in the organisation and technique of the dairy industry in recent times, which may be expected to continue and to have a favourable influence upon the output and exportable surplus of dairy products. Unless non-agricultural industries expand rapidly in the future, it is probable that there will be a gradually increasing surplus of dairy produce and possibly also of live and dead meat from Sweden for some years, when pre-war conditions of trade have been restored.

(d) IRELAND.

The importance of Ireland as a source of supplies of animal foodstuffs is apt to be obscured owing to the customary inclusion of Irish trade statistics with those of the United Kingdom. When the Irish statistics relating to animal foodstuffs are considered separately, the deficiency position of Great Britain becomes more conspicuous; needless to say, the exports of such foodstuffs from Ireland are almost exclusively to Great Britain.

Ireland in recent years has specialised more and more in animal industries, the productiveness of which has increased owing to improved organisation and to technical progress, while the population has remained almost stationary. The following table shows the numbers of the various kinds of food-producing animals and of "cattle units" per 100 of the population in the years 1901 and 1913.

	CATTLE	SHEEP	PIGS	" CATTLE UNITS "
1901	105	98	27	154
1913	113	83	24	157

As compared with Denmark, which has the highest per capita and per acre ratio of "cattle units" among European countries, Ireland shows higher per capita ratios of cattle and sheep, but a much lower one of pigs. The increase in the ratio of pigs to the population has been much more rapid in Denmark than in Ireland, where pig-raising recently received a check owing to the increasing price of feedstuffs and the greater profitableness of the poultry industry.¹ It will be observed from the above table that Ireland is

¹ Departmental Committee on the Irish Pig-breeding Industry. Minutes of Evidence (Cd. 8004), p. 7.

no exception to other European countries in the decline in the ratio of sheep to the population in recent years. As in most of these countries, the decline in sheep in Ireland has been not only relative to the population, but also absolute.

The increase in the ratios of "cattle units" to the population has naturally led to an increase in the exported surplus of animal foodstuffs.¹ The most considerable item among the Irish exports of animal foodstuffs consists of live animals, other less important items being butter, bacon and eggs. Of the live animals exported, cattle have much the greatest value, and of these about 50% on an average are fat cattle ready for slaughter; of the sheep exported about the same proportion are lambs, while the pigs are practically all fat heavy-weights. The following table shows the numbers and values, as well as the total values of the food animals exported from Ireland in 1905 and in 1913.

EXPORTS OF LIVE FOOD ANIMALS FROM IRELAND.

	NUMBER	VALUE £ MILL.	NUMBER	VALUE £ MILL.
Cattle ...	749,934	8,928	1,109,621	15,464
Sheep	703,842	1,256	659,255	1,273
Pigs	363,823	1,272	209,296	1,024
Totals	<hr/>	11,456	<hr/>	17,761

A detailed examination of the import and export trade figures for Ireland in 1913 shows that the total exports of animal foodstuffs (including live meat animals) amounted in value to £30·5 million. while the corresponding imports were valued at £3·7 million, of which frozen meat accounted for the greater part; so that there was a balance of net exports valued at £26·8 million. When, however, the trade in cereals and feedstuffs is considered, it is found that the total imports under this head, amounting to £12·3 million, exceeded the exports (in value £0·84 million) by almost £11½ million. Of the total net imports of cereals and feedstuffs valued at about £11½ million, not less than £6 million would be accounted for by materials used as feedstuffs for food animals. By subtracting imports from exports tables it will be seen that the value of the balance of net exports of the principal items of foodstuffs amounted in 1913 to over £15 million, while when animal indus-

¹ Generally speaking, an increase in the ratios of "cattle units" to the population in a given period in a surplus-producing country results in a greater corresponding increase in the exports of animal foodstuffs, owing to the increased productiveness of animals per unit, which has been fairly general in recent years. If, however, the local per capita consumption of animal foodstuffs increases in the interval, exports are reduced and this difference may disappear.

tries alone are considered, the value of the balance of net exports was nearly £27 million in the same year. The total value of the imported feedstuffs is considerable, and the country depends to a large extent upon imported supplies of wheat and other cereals for human consumption, so that Ireland is not improperly classed with Denmark and Holland as being of the elaborating-commercial type with regard to its animal industries. The natural conditions in Ireland favour pastures and potato crops and these are the basis of the stock-rearing industries, but without imports of concentrated feedstuffs the present position of those industries would be threatened, and they would be completely disturbed, if the country were compelled to grow its own requirements in food cereals. Two of the important branches of animal industries in Ireland, namely pig-rearing and egg-production depend in no small measure upon imported supplies of feedstuffs, and the great dairy industry to which each of these is to some extent tributary, likewise demands imported feedstuffs, for the successful carrying of dairy cows through the winter.

Concerning the consumption of animal foodstuffs in Ireland, the facts are not so easily ascertainable as in the case of other countries. In general it is safe to assume that the per capita consumption of most animal foodstuffs is below the level of the whole United Kingdom ; and it is probably higher in the industrial area of the north than elsewhere, so that any increase in the proportion of the population of that area to that of the whole of Ireland would be likely to cause an increase in the per capita consumption of the country. However, there has certainly been a general increase in the prosperity of Irish agriculture in recent years, and these improved conditions appear likely to continue. This change is likely to produce an increase in the per capita consumption of animal foodstuffs in Ireland, if it has not done so already, and this would tend to reduce the exportable surplus.

The outlook for the increased production of animal foodstuffs in Ireland in the near future is, on the whole, promising. The country is no longer over-populated, and the resources in soil and climate can now be directed to the production of those things for which they are best suited, namely, animal foodstuffs ; the oceanic climate, while unsuited in general to cereal crops, except perhaps oats, is admirably adapted to the production of forage crops and pasture grasses ; and the reforms in the system of land tenure and the spread of scientific methods and proper agricultural organisation are likely to assist in the progress of Irish farming. There appears to be no reason why animal industries in Ireland should not become considerably more intensive, given facilities for importing concentrated feedstuffs from abroad. It is distinctly possible when peace conditions are restored, that both the gross production and the exportable surplus of animal foodstuffs in Ireland may increase considerably, as has happened in the case of such articles as eggs and butter in quite recent years.

CHAPTER VII.

DEFICIENT INDUSTRIAL COUNTRIES AND REGIONS.

THE fourth group of countries described in Chapter II., above, are distinguished by the fact that they contain large industrial populations and look to the export trade in manufactured goods, as the main source of their wealth ; and they have to rely upon foreign sources for some part of their supplies of raw materials and of foodstuffs. From the point of view of this enquiry they form the markets to which the surplus supplies of animal foodstuffs and feedstuffs gravitate either directly or indirectly ; they are the apex of the pyramid in the world's production and trade in these classes of produce.

No single country in the world is, fortunately for itself, entirely industrial in its structure, and all the deficient industrial countries have important animal food-producing forms of agriculture, utilising as feedstuffs both home-grown and imported concentrated materials, as do the elaborating commercial countries of Group III. With the exception of Great Britain, all of them have some special kinds of foodstuffs, including in some cases even those of animal origin, for export trade. It has already been observed that deficient industrial "islands" exist in regions of the surplus-producing group, and that such isolated industrial areas draw upon the rest of the political unit in which they are found, and sometimes partly also upon the outside world, for their supplies of foodstuffs. Under the existing territorial arrangement of the world, the true nature of these areas is apt to escape notice in a study of international trade. If, for example, the New England States of America formed a separate political unit, they would appear as a marked type of the deficient industrial regions.

It is worth noting also that all civilised countries, and especially those here termed deficient industrial, tend to produce an independent rentier class of population of high per capita consumption of animal foodstuffs. Some centres, such as London and Paris, have special attractions as the residential headquarters of such people, who came thither in considerable numbers from other parts, not only of the same country, but also of the rest of the European world. Similarly, also, certain health and scenic resorts such, for example, as Switzerland, have to provide for a large additional population of this kind, at any rate during part of the year. Obviously the deficiency position of any area is increased by the extent to which people of wealthy independent means, who are in no sense producers of foodstuffs, make it their temporary or their permanent home.

It is natural that in all areas of the deficient industrial type the consumption of animal foodstuffs should be of greater comparative importance than in countries belonging to the other groups; and it is now proposed to consider the production of animal foodstuffs in certain countries of this class with special reference to their consumption of the same articles. Those selected are Great Britain, Germany, France, Belgium, Austria-Hungary and Switzerland.

(a) GREAT BRITAIN.¹

In Great Britain and in the United Kingdom, between the years 1890 and 1913, there was a decline in the per capita ratios of all important classes of live stock including milch cows, and there was further an absolute decline in sheep and swine. Nevertheless the people of the United Kingdom increased their per capita meat consumption during this period² and drew an increasing, rather than a diminishing proportion of the total, from home sources. There was, therefore, a general increase in the productiveness of meat-producing animals as enumerated, owing to a more rapid "turnover." The imports of butter, however, increased considerably, owing to the fact that an increasing proportion of the milk produced was required for consumption as such with the growth of population, milch cows having declined in proportion to the population. In fact, during the period under review, so far as animal industries are concerned, dairying was to some extent sacrificed to meat production.

A survey of the consumption of animal foodstuffs in Great Britain in the period from 1890 to 1913 points to a rise in the general standard of living. Not only was there some increase in the per capita consumption, but there was also apparently a considerable increase in the fish supplies per head, while the per capita consumption of butter with margarine and of eggs showed no tendency to fall. Cheese was rather an exception in this direction among animal foodstuffs, the per capita consumption having fallen during the period, owing, it is said, to relatively abundant supplies of imported meat. This general rise in the consumption of animal foodstuffs and of fish which has taken place in Great Britain points to the fact that among European populations there is still abundant room for a rise in the general rate of consumption of these foodstuffs, if conditions are favourable; it is well known that in Great

¹ Ireland has been considered separately in the previous chapter, and the survey of the facts with reference to production and surplus there made throws a useful sidelight on the situation in Great Britain. In the present chapter, it has been found convenient at times to refer to the United Kingdom as a whole, since it is very difficult to present concise figures with regard to exchange trade and consumption separately for the two countries, but the facts relating to Ireland should be borne in mind.

² The per capita meat consumption rose from about 112 lbs. in the years 1890-5 to about 120 lbs. in the period 1909-12, though the yearly figures show a decline from 1906 onwards.

Britain there were large classes which habitually consumed smaller quantities of animal foodstuffs than they desired, less even than they required on physiological grounds.

During the period above selected, the United Kingdom, and still more, Great Britain, became, as is well known, more and more a deficiency area in practically all kinds of agricultural produce. The fact that the home supplies of meat were maintained at about the same proportion to total consumption is apt to be deceptive, since there was an increase in the per capita quantities of animal feedstuffs imported, equivalent in reality to imports of meat and other animal foodstuffs; and correspondingly at the same time, there was a decline in the per capita production of all of such feedstuffs as are produced within the country.¹ Moreover, the production of meat was maintained not only by giving it preference to dairying, but also by reducing the area devoted to cereals (especially wheat) for home consumption and increasing correspondingly the area of meat-producing grass lands. It is worth noting once more in this connection that over one quarter of the wheat imports by weight normally become feedstuffs in the form of milling offals.

With regard to the separate kinds of meat consumed in both the United Kingdom and Great Britain, mutton and lamb constitute a higher proportion than in any country in Europe or in North America, while pig-meat forms a correspondingly lower proportion of the total meat consumed. Not only is this so, but in the period 1900-13 the per capita consumption of mutton and lamb tended to rise, while that of pig-meat tended to fall. These peculiarities in consumption may not be altogether unconnected with the conditions of production within the country, in spite of very large importations which tend to make the total supplies of the different kinds of meat available independent of the limitations set by home production. It is remarkable in this connection that among the industrial countries Great Britain has much the highest per capita ratio of sheep and the lowest per capita ratio of pigs. The large area of uplands of calcareous formation, together with the wide use of fodder and root crops for fattening purposes account for the high numbers of the former, while the relatively small quantities of skim-milk arising as a by-product from butter manufacture, and the almost complete absence of home-grown concentrated feedstuffs suitable for pigs, causes the numbers of these animals to be exceptionally low as compared with other countries.

In recent years the population of Great Britain, as a whole, has become increasingly concentrated in towns, and dependent upon manufacturing industries and trade as a means of livelihood. The extreme deficiency of the country in foodstuffs tends to be increased

¹ The per capita production of oats in the United Kingdom fell from 4·7 bushels in 1890 to 3·7 bushels in 1913, that of barley from 2·2 bushels to 1·5 bushels, that of hay from ·3 to ·2 tons.

by the existence of a large rentier class. In the near future there appears to be every likelihood of a further expansion in manufacturing industries, while with regard to the production of animal foodstuffs it seems that there can under the present conditions, be no great increase without largely increased imports of animal feed-stuffs.¹

(b) GERMANY.

In the years prior to 1914 the per capita consumption of meat in Germany was steadily increasing, and by 1910 had nearly reached that of the United Kingdom.² Much the greater proportion of the total consumption of meat and meat products was produced within the country, though in spite of all efforts to the contrary there was a growing dependence upon outside sources of supply for almost all kinds of animal foodstuffs.³ The following table of the per capita ratios of food-producing animals to the population in different years, taken in conjunction with the increased per capita consumption of meat, explains this change.

Year	Cattle per 100 population	Sheep per 100 population	Pigs per 100 population	"Cattle Units" per 100 population
1892	35	27.0	24	69.6
1905	33.6	17.2	29.8	73.8
1914	30.5	8.8	33.2	73.5

It will be seen that the meat-producing live-stock, in terms of cattle units per 100 of the population, increased by 4.2 units between 1892 and 1905, but declined by .3 units between 1905 and 1914. Now a calculation shows that each "cattle unit" produces on an average about 135 lbs. of meat per annum, and a decline of .3 units per 100 of the population would mean a decreased meat yield of about $\frac{2}{5}$ lbs. per head, while the per capita meat con-

¹ For a further discussion of the problems relating to the increased production of foodstuffs in Great Britain and the United Kingdom, see Part III., Chap. II., pp. 292-297.

² The following figures have been given for the per capita consumption of meat in Germany at different dates:—

1894—88 lbs.

1908—115.6 lbs.

1902—99 lbs.

1913—111.8 lbs.

The per capita consumption of meat in the United Kingdom in 1909 was about 119 lbs.

³ The total imports of meat and meat products (mainly fats and oils) into Germany were 389 million lbs. in 1910 and 591 million lbs. in 1912 (U.S. Dept. of Agric. Rept., 109). These figures do not include the imports of meat-producing live animals from neighbouring countries which in 1912 were valued at about £4½ million and at an average of 6d. per lb. of dressed-weight meat produced, would represent an additional 190 million lbs. of imported meat. This would bring the total imports up to 780 million lbs. in 1912 or approximately 10% of the total supplies.

sumption of Germany increased by about 13 lbs. in the period 1902-1913. No doubt part of this difference can be accounted for by the increased productivity of animals, but the greater part was made up by increased imports of meat and of meat-producing live animals.

A further examination of the table above shows that there was a marked decline in the ratio of sheep and a marked rise in that of pigs. In the business of meat-production Germany has advanced further than most countries in substituting the more economical pig for the less economical sheep. A number of causes have contributed to this rapid change: forest plantations occupy to a great extent what might otherwise be sheep walks; wool could be imported from the Southern Hemisphere; the enormous production of potatoes in excess of human food requirements, the great number of small holdings, and the ease with which feedstuffs could be imported by sea and from Russia and South Eastern Europe, favoured pig-rearing; and finally, the taste for fats and fat meat characteristic of the German people made pork more popular than mutton, which, moreover, is less suitable for preservation in the form of sausages. In the matter of dairy produce, also, Germany showed in the years prior to 1914 a considerable deficiency. In the total imports of these articles Germany was second only to the United Kingdom. In addition to net imports of butter, cheese, and even of cream and milk valued together at about £8½ million, on an average of the years 1911-12, large quantities of raw materials for margarine in manufacture entered the country.¹ Germany, as a whole, has never excelled as a dairying country. Except in the north-west, the conditions of soil and climate are more favourable to other forms of agriculture. Specialised dairy breeds of cattle are rare, and the average milk production per cow somewhat low.²

The German consumption of poultry and eggs likewise exceeded the home production by large quantities. Poultry meat has been popular in Germany owing to its comparative cheapness and to habits derived from previous times when the majority of the population lived either in, or within easy reach of, the agricultural districts where poultry have always been numerous in connection with grain-growing. Proximity to Russia has caused imported poultry and eggs to reach Germany easily and cheaply. The total

¹ The total value of the net imports into Germany of oil-seeds and nuts averaged over £13 million in the years 1911-12, and that of the oleo-margarine, premier jus and tallow nearly £3 million. Perhaps about £8 million would represent the total value of the materials used for the manufacture of margarine. On the other hand, the net exports of margarine averaged £1½ million in value. These and other figures of German import and export trade given in this section have been taken from the *Statistisches Jahrbuch*, 1913.

² The average milk production per cow in Germany some years ago was estimated at 366 gallons compared with 420 gallons at the same time in the United Kingdom. See Rew, *Statistical Journal*, 1904* pp. 417 and 423.

net imports of poultry and eggs into Germany from all sources, on an average of the years 1911-12, were valued at about £14 million which represents a greater sum than that of the corresponding imports into the United Kingdom in the same year.

When animal feedstuffs are considered, it is again found that the imports into Germany were considerably in excess of the exports, the difference under this head (including the offals from excess imports of food-cereals), amounting in value in the years 1911-12 to an average of about £55 million.

It thus appears that in the years prior to 1914 Germany showed a marked deficiency in both animal foodstuffs and animal feedstuffs, and in this respect was second only to the United Kingdom.¹ The position was becoming more marked every year with the growth in the numbers and the purchasing power of the population. It is true that in other kinds of agricultural produce Germany was better able to supply its own needs from home sources than was the United Kingdom; indeed, in two articles, namely, alcohol from potatoes, and sugar, there was a considerable exported surplus, which, however, was by no means equal in value to the net imports of food-cereals. Whatever the issue of the European War may be, there is no doubt that Germany will be far from able to satisfy the requirements of its population in animal foodstuffs in the future from its own resources, unless the per capita consumption is reduced permanently to a much lower level than that existing prior to the War. Sooner or later, according to the speed of recovery from the effects of war, Germany will become a more extensive purchaser of the world's exportable supplies of animal foodstuffs than ever was the case in the past, and the serious competition arising from Germany for a share of the available exports from the surplus-producing countries will not be without its effects upon trade and prices.

(c) FRANCE.

In the matter of all classes of foodstuffs taken together, France is, on the whole, nearly self-sufficing, though figures of the import and export trade since 1900 show a growing excess of net imports. In animal foodstuffs there were constant, but not very considerable, imports of meat and meat products² in addition to certain numbers of live food animals imported from the Colonies.³ On the other hand, there have been considerable exports of dairy produce,

¹ See Table, p. 34, above.

² The annual imports of meat and meat products into France (mainly from the United States) averaged about 100 million lbs. for the period 1896-1912.

³ The most considerable item under this head has been the imports of sheep from Algeria. More recently a trade has arisen from Madagascar, but owing to the distance and the expenses of transportation, this trade tends to be more in the form of dead meat than of live animals (*Annales de Géographie*, March, 1916, pp. 92, 93).

butter being the most important item ¹; and appreciable numbers of live cattle have been exported overland by way of the eastern frontier.² France has been a surplus producer of poultry and eggs, but exports declined between 1900 and 1913.

When the ratios of live-stock to the population are considered, it is observed that France has maintained, and even slightly increased, these ratios on the whole. The following table shows the numbers of the different classes of food-producing animals and of "cattle units" per 100 of the population in the years 1890 and 1913:—

	ALL CATTLE	DAIRY CATTLE	SHEEP	PIGS	" CATTLE UNITS "
1890	35	17	56	16	65
1913	37	20	41	18	67

The increase in the ratios of all cattle and of dairy cattle are exceptional as compared with the movements in most other European countries, while the decline in that of sheep and the increase in that of pigs are in common with the changes in neighbouring countries. It is noteworthy, in connection with the above table, that in the period 1890 to 1913, the per capita production in France of oats, barley and hay remained nearly at the same level in each case throughout.

It is well known that the population of France has been more or less stationary during the last two decades, and this, combined with the fact that the soil is naturally fertile, has enabled the country to maintain its per capita ratios of food-producing animals and to increase its production of animal foodstuffs without any extensive imports of animal feedstuffs or of food cereals. During the period taken above the per capita consumption of animal foodstuffs rose appreciably, if that of meat ³ is taken as a guide. With regard to dairy products, the per capita cheese consumption was high, while that of butter was low in 1892. The latter has

¹ In 1912 France exported about 17,000 tons of butter, about 12,500 tons of cheese, and about 5,600 tons of margarine, while there were imports of butter of about 6,400 tons and of cheese of about 21,500 tons. France is, therefore, a surplus-producing area in butter and margarine, but is a deficiency area in cheese.

² In 1913 the net exports of cattle from France were 57,000 head and of calves 84,000 head, while in the same year the net imports of sheep were 925,000 head and of pigs 188,000 head. When these items are reduced to terms of the dressed-weight meat yield, it is found that the exports were less than the imports.

³ The per capita consumption of meat, other than horse-flesh, rose from 35 kilograms in 1892 to 45 kilograms in 1912 (Internat. Agric. Inst., *Bulletin*, Nov., 1912, p. 185).

probably risen since that date, though it should be remembered that edible oils, especially olive oil are widely used as butter substitutes in France. As a consequence of the general increase in the per capita rate of consumption of animal foodstuffs, there was a tendency for a shortage to appear especially in meat, in the years after 1908, in spite of the rise in the ratios of live stock to the population and of the probable greater yield of foodstuffs per unit of stock.

With regard to the future, it may be predicted that when the normal course of life has been resumed after the war, the country will in the main be able to furnish its own supplies of animal foodstuffs. It may be some time before the numbers of the live stock, which have suffered very severely owing to war conditions, are restored to their previous levels; and during this interval abnormal imports of animal foodstuffs, particularly of meat, may be necessary to furnish even considerably reduced per capita rations. On the whole, however, the population is not likely to increase appreciably in the near future, nor the standard of living to rise rapidly. Manufacturing industries in France have not expanded quickly in the past as in some other countries, and they probably will not do so in the near future. When peace conditions are properly restored, it seems likely that any deficiency in animal foodstuffs will be more or less covered by supplies from the French Colonies.

(d) BELGIUM.

This small country carries normally a dense population which, so far as animal foodstuffs are concerned, subsists mainly on supplies produced at home. Prior to 1914, however, there were considerable excess imports of food cereals and of animal feedstuffs into the country¹ without which it would have been totally impossible for the large industrial population to have its requirements in food satisfied.

In the years preceding the outbreak of the war the per capita consumption of animal foodstuffs was moderately high, and tended, apparently, to increase.² Figures are available for 1902, in which year the per capita meat consumption has been estimated at 70 lbs., and the per capita butter consumption at 25 lbs.; the latter

¹ The following table shows the net imports into Belgium of different kinds of animal foodstuffs and of grains and oil-seeds in the years 1901 and 1912:—

	Live Animals (excl. horses).	Meat mill. lbs.	Fats and Oils mill. lbs.	Butter mill. lbs.	Grain mill. tons	Oil seeds mill. tons
1901	222,882	8.6	—2.0	1.9	1.68	.24
1912	260,746	12.5	27.6	12.5	2.66	.42

² This appears to be the case from the fact that while the combined live-stock ratio increased appreciably from 1900 onwards, the net imports of animal foodstuffs also increased noticeably.

is higher than for most other countries. When the ratios of food-producing animals to the population are considered, it is found that in the 18 years prior to 1914 there was some upward movement. This appears, from a study of the numbers of "cattle units" per 100 of the population, which rose from 42.6 in 1895 to 43.9 in 1900 and to 47.6 in 1913. The number of "cattle units" per head of the population is comparatively small, but animal industries are conducted on a very intensive system, and the yield in meat and dairy produce per unit is probably greater than it is in France or Germany, which have higher ratios. Concentrated feedstuffs and fodder crops are necessarily used to a very large extent in rearing animals in a country such as Belgium, where the proportion of pasture lands to the total area is especially small. As a matter of fact, and in consequence of this practice, Belgium carries more cattle per acre than any other country.¹ It is obvious that Belgium resembles the elaborating-commercial countries in being dependent, to a considerable extent, upon imported supplies of concentrated feedstuffs for the maintenance of its food-producing animals.

With regard to the near future, forecasts are difficult. Much depends upon the rate at which the country recovers from the effects of the War. It is doubtful whether there will be any marked increase in the population for some years to come, even if the manufacturing industries rapidly resume their former flourishing condition. It is certain that the live-stock of the country have been severely depleted during the German occupation, and it is probable also that the fertility of the soil will have suffered impairment. When peace conditions are restored, the animal industries of the country cannot therefore be equal to supplying the requirements of consumption on the pre-war basis; and unless the per capita consumption of animal foodstuffs remains at a reduced rate, considerable quantities will require to be imported to supplement home production. In the long run, Belgium may come to be largely self-supporting in the matter of these foodstuffs, though the extent of the imports will depend, in no small measure, upon purchasing power in relation to supplies and prices. There will always be large importations of animal feedstuffs and of food cereals, owing to the existence of a large population concentrated on a small area. The industry and the technical skill of the Belgian peasants are noted, and these qualities may serve to restore the agricultural industries of the country rapidly to a condition of high productivity.

(e) AUSTRIA-HUNGARY.

This region, which lies astride of the boundary line adopted above as separating Western from Eastern Europe,² consists in reality of two distinct areas from the point of view of this enquiry;

¹ Rowntree, *Land and Labour: Lessons from Belgium*, p. 180.

² See Part I., Chap ii., p. 23.

in general terms, Austria (including Bohemia) is an industrial and deficiency region, while Hungary, with Galicia, which are predominantly agricultural, form a surplus-producing area. The latter was considered incidentally in the section dealing with Eastern Europe, but a fuller discussion of the leading facts is now proposed in connection with Austria.

Statistics show that the ratios of food-producing animals to population, expressed as "cattle units," have been increasing in Austria, while they have been declining slightly in Hungary, as shown in the following table:—

NUMBERS OF CATTLE, SHEEP AND PIGS AND OF CATTLE UNITS PER 100 OF THE POPULATION IN AUSTRIA AND IN HUNGARY IN SELECTED YEARS.

	YEARS	CATTLE	SHEEP	PIGS	" CATTLE UNITS "
Austria	1890	36	13	15	56
"	1910	32	8	23	62
Hungary	1884	34	68	34	88
"	1911	35	41	36	87

A study of this table shows that the ratios of live stock to population are higher in Hungary than in Austria, which, prior to 1914, imported fluctuating quantities of meat through Adriatic ports and from Servia,¹ and in spite of this, experienced at various times a meat shortage.² The ratio of cattle units to the population is distinctly higher in Hungary than in most European countries, and unless the per capita meat consumption is abnormally high, or the yield of meat per unit of animals unusually low, should be sufficient to allow of a surplus of meat for export.³ A study of the per capita production of animal feedstuffs in the two countries is interesting, when taken in connection with the changes in the per capita ratios of food-producing animals. Thus in Austria, in the period 1890 to 1910, while the ratio of cattle units to population increased, there was a fall in the per capita production of maize, oats and barley, that of hay remaining stationary; conversely, in Hungary in the period 1884 to 1911, while the ratio of "cattle units" to population declined slightly, there was an increase in the per capita production of all four of the feedstuffs mentioned above. These facts point to the movement of cereal feedstuffs

¹ The imports of meat and meat products into Austria-Hungary for the period 1895-1912 averaged 31 million lbs. per annum, but fluctuated from 78 million lbs. in 1898 to 2 million lbs. in 1909.

² See U.S. Daily Commerce Report, Dec. 17th, 1910, p. 1033.

³ In the years 1901-12 there were constant net exports of live animals (other than horses) from Austria-Hungary.

from Hungary to Austria.¹ It will be observed from the table above that there was a marked decline in the sheep ratios in both countries during the periods taken. This decline was also an absolute one, amounting in each case to about 40%. In Austria cattle declined also absolutely to a small extent, and in ratio to the population as much as 11%. The smaller numbers of cattle and sheep in Austria and of sheep in Hungary in the more recent year as compared with the earlier, are apparently due to a reduction in the areas of grazing land available. The advancing population, combined with restrictions as to the importation of cereals, caused land to rise in value, and made stock-rearing on the grazing system less profitable. It is noteworthy that as in Germany, the decline in sheep in Austria-Hungary was accompanied by a marked increase in the numbers of pigs both absolutely and in ratio to the population. It thus appears that the people of Austria-Hungary came to depend more upon pig-meat and less upon beef and mutton, in their supplies of animal foodstuffs. The plains of Hungary are well adapted in climate and soil to the production of cereals, including maize, and thus furnish the raw material in the form of feedstuffs which is the basis of the increasing pig-rearing industry. At the same time potatoes and barley are grown extensively in Austria, and these crops furnish valuable rations for pig-fattening purposes.

With reference to animal feedstuffs, Austria-Hungary, as a whole, is deficient in maize, but has a surplus of barley. On an average of years these two items approximately balance each other by values, so that the region is more or less self-contained in this respect. Much of the exported barley, however, is essentially destined for brewing purposes, and not more than one-half of it by values can properly be taken as feedstuffs.

In animal foodstuffs Austria-Hungary has a declining surplus of meat,² has small net exports of butter and margarine, and very extensive net exports of eggs, the latter being produced especially in Galicia and Hungary. Eggs are distinctly a product, as has been noted above, of grain-growing regions and a continued surplus is therefore to be expected in the future from these characteristic cereal lands.

With regard to the future, any shortage in animal foodstuffs is most likely to be felt in the direction of beef; and beef, as it happens, can be most easily imported from abroad. To what extent beef or any other kind of meat or meat products will be imported, depends upon the economic prosperity and the consequent purchasing power of the people of Austria in the industrial towns, upon the rate of development of animal industries in Hun-

¹ In 1911 Hungary exported about 2.4 million tons of cereals and flour in addition to large items of food, animals and animal produce (*Annuaire Stat., Hongroise*, 1911). There is no doubt that an important part of these exports were sent to Austria for consumption there.

² Live animals other than horses being reckoned as meat.

gary, and, as in Germany, upon the nature of the post-war tariffs on imported meats and cereals. When peace conditions are restored, it is probable that an acute shortage in animal foodstuffs will for some time be felt in Austria, and the country may become a competitor upon the world's markets for beef, and perhaps even mutton, on a much larger scale than hitherto ; on the whole, however, this seems much less likely than in the case of Germany.

(f) SWITZERLAND.

Switzerland has a moderately dense population, living upon an area a full quarter of which is quite unproductive ; the density in that part of the country which can support life in any form is exceeded by that of but few countries in Europe. In recent years an increasing proportion of the Swiss people have become engaged in manufacturing industries, and the country has become correspondingly less able on the whole to meet the requirements of its local and its tourist population from its own agricultural resources. At the present time, therefore, and probably still more so in the near future, Switzerland is to be regarded as a deficient industrial country. Even in 1911 the number of persons employed in industry was nearly equal to the total of those employed in all agricultural industries together with forestry.

The deficiency of Switzerland in foodstuffs is most conspicuous in cereals, and this denotes a corresponding deficiency in animal feedstuffs. The chief source of agricultural wealth in the country lies in the rich Alpine pastures which have led to a specialisation in the cheese-making form of the dairy industry. In spite, however, of extensive exports of cheese and condensed milk, both of which increased rather than diminished in the years preceding 1914, Switzerland has regularly imported large net quantities of meat (including live food animals) and of butter. A summary view of the position of Switzerland with regard to the leading items of foreign trade in animal foodstuffs and feedstuffs in the years 1911-1912, averaged together, is given on p. 34 above. From these figures it will be seen that the country was then, on the whole, a deficiency area in respect of these articles by values. A detailed consideration of all items reveals more clearly the insufficiency of the local animal industries to supply the Swiss requirements in the corresponding foodstuffs in the years immediately before the War. It appears that by values the net imports of live food animals were nearly equal to the net exports of cheese, and that the milk equivalent of the imported butter and cheese was about half that of the exported cheese. The weakness of the country in cereal feedstuffs is reflected in extensive imports of eggs.

A study of the live-stock statistics shows that the per capita ratios of all kinds of food animals declined between 1886 and 1911 ; that sheep have declined absolutely, till now their numbers are insignificant, scarcely exceeding that of a single large Australian flock ; that goats are numerically of greater importance than

sheep ; that, while the numbers of all cattle and of pigs increased between 1901 and 1911, their per capita ratios declined in the same period ; and that in this period there was a marked decline both in the absolute numbers and especially in the per capita ratio of dairy cattle. These facts are shown more concisely in the table below, which gives the numbers and the per capita ratios of the various kinds of food animals in Switzerland in selected years.

	1886		1901		1911	
	No. (Mill)	per cap.	No. (Mill)	per cap.	No. (Mill)	per cap.
All cattle ...	1·2	·42	1·34	·40	1·44	·38
Dairy cattle	·85	·29	·98	·29	·80	·21
Sheep.....	·34	·12	·22	·07	·16	·04
Pigs	·39	·14	·56	·17	·57	·15
Goats.....	·42	·14	·35	·10	·34	·09
" Cattle Units " ...		·63		·63		·59

It is remarkable that while dairy cattle declined in per capita numbers between 1901 and 1911, the quantities of both cheese and condensed milk exported increased regularly at the same time. This may be explained to some extent by the increased imports of concentrated feedstuffs. Thus in 1912 the imports of barley were three times the quantity imported in 1901, while the imports of maize and of oats were each about double those of the earlier year. The conclusion is that the dairy industry of Switzerland became more intensive and the milk yield per cow was considerably increased by the use of imported feedstuffs as supplementary material, particularly for winter feeding.

The above survey of the situation in Switzerland does not promise any increase in the ratio of the exports of animal foodstuffs to the imports of the same together with feedstuffs in the future. At the present time the land is made to produce practically the utmost possible by an industrious population, often under most laborious conditions. With the abundant supplies of water power available in the country it is probable that an increasing proportion of the Swiss will be employed in manufacturing industries, while with the return to peace conditions there will be a re-influx of the non-productive visiting population, so that without greatly increased imports of feedstuffs Switzerland will be quite unable to supply an increasing surplus of animal foodstuffs, even of those specialties in which it has become famous, to other deficiency countries.

CHAPTER VIII

ANIMAL INDUSTRIES IN THE PROGRESS OF AGRICULTURE

IT has been shown in Chapter II., above, that there has been a decline in recent years in the numbers of food-animals throughout the world, relative to the white population. The resulting meat-shortage would have been more keenly felt had it not been for improvements in the breeds and the general quality of the animals, which have led to a greater annual production of animal foodstuffs per unit enumerated.

In Western Europe, which contains over one-third of the world's white population, and probably consumes about one-half of the world's supplies of animal foodstuffs, the number of food-animals expressed in "cattle units" increased at a slower rate than the population in the period 1900 to 1912; the latter increased by 10·6%, while the former increased by but 9·5%. In the same area dairy cattle rose from 33·46 million in 1900 to 33·94 million in 1912, other cattle from 31·01 million to 33·32 million, and pigs from 36·7 million to 45·2 million, while sheep declined remarkably from 67·65 million to 57·85 million.¹ An examination of these totals shows that between 1900 and 1912 the numbers of "other cattle" (calves and beef cattle) in Western Europe increased by about 7% and those of dairy cattle by about 1½%. This does not necessarily mean that the output of beef increased more rapidly than that of milk; the reverse was probably the case, on the whole. In the same period the table shows that the number of sheep in Western Europe declined sharply, while that of pigs increased at a marked rate. The great decline in the numbers of sheep taken in conjunction with the comparatively small increase in the numbers of all cattle, indicates perhaps that Western Europe has reached a kind of saturation point in the matter of pasture-fed live stock. The remarkable absolute decline in the numbers of sheep is due to the fact that these animals have been driven from their former pastures by the advance of crop cultivation, and in some cases by afforestation. Pigs have increased in numbers relative to the population because they are better suited to the more intensive methods of farming and because concentrated feedstuffs could be imported in increasing quantities.

¹ For certain countries the enumerations for the years nearest to 1900 and 1912 respectively have been taken in those cases where no figures are available for those years. Italy, Portugal and Spain have been omitted because of the absence of any distinction between dairy and other cattle in official statistics. The omission of these countries does not affect the totals for comparative purposes.

In the regions outside Western Europe, taken together, there has been a comparatively slow increase in the exported surplus of meats and dairy produce since the year 1900, owing chiefly to the rapid decline in the North American supplies.¹ Moreover, there was an increasing tendency for consignments of live food-animals, meat and butter to be sent from certain of these regions to others in the same group rather than to Western Europe.

It is clear that questions of soil fertility and the operation of the rule of diminishing returns present some kind of limitation at the present time upon constantly increasing production of animal foodstuffs from the countries already under contribution. Countries are found in all stages of development in animal industries, and the history of agricultural progress tends to follow the same general course in all new temperate countries. At any given moment the operation of diminishing returns affects different countries unequally, and is by no means uniformly progressive. It may march rapidly as long as an extensive system is followed, but may be reversed at a later time when a more intensive system is introduced. Where animal industries are followed, diminishing returns are seldom very obvious unless over-stocking has been pronounced, and these industries constitute one of the most ready means of restoring fertility lost by excessive cropping. Obviously, however, limits always exist as to the number of stock that a given area of land will carry unless feedstuffs are purchased from elsewhere, since food-animals live entirely upon plant produce. In the last resort, therefore, when land is a limited quantity, the increased production of animal foodstuffs depends upon proper supplies of fertilisers. Experience shows that for maximum production per acre (and often for maximum profits as well), the more diversified the farm organisation is, the better²; but the ultimate problem is to increase constantly the quantity of plant food for man or beast which the average acre yields.

Under simple pastoral conditions, the losses in soil fertility tend to be balanced by the gains, but even natural pastures will not bear stocking beyond a certain point. Over-stocking leads to a partial or a complete destruction of the native grasses as experience in North and South America has shown.³ Provided, however,

¹ The quantities of butter and of cheese which reached Western Europe from these regions increased noticeably after the year 1900, owing to the large exports of butter from Siberia and New Zealand and of cheese from the latter country, which more than balanced decreased exports from North America. The slow increase in the meat surplus from these regions is not surprising in view of the fact that whereas in the period 1901 to 1912 the exports of live animals (reduced to dressed weight), meat and meat products from the United States declined by about 570,000 tons, those from South America, the only other region that shows a marked increase, rose by about 300,000 tons only (that is, reckoning only the *net surplus* of live animals, together with that of meat and meat products from Argentina, Uruguay, and Chile combined, and omitting all items of trade between these countries).

² See U.S. Dept. Agric., *Bulletin* 41, 1914, especially p. 30.

³ See U.S. Dept. Agric., *Bulletin* 34, p. 2.

that the numbers of live-stock are kept within proper limits, and the pastures are given the periodical rests that they require, it seems that under ordinary conditions such lands will continue to carry stock and to produce wool and meat over extended periods of time, without the risk of any serious decrease in the product. However, only land remote from centres of population can be used profitably in this way for lengthened periods.

Sooner or later, there usually comes a stage where cropping in some form is resorted to, in order to obtain an increased quantity of animal produce. Hay is ordinarily the first crop, and this crop, if fed to animals that remain on the land till sold in a more or less finished state, may be taken in successive years without the use of fertilisers; this practice may not result in soil exhaustion, provided as before that the pastured stock is not excessive. A hay crop really results in a smaller number of animals being carried in summer and a larger number in winter than would otherwise be the case. Three to four acres are required in most countries to maintain one head of cattle under these conditions. The yield in meat per acre per annum is low, and it is presumed that the rate of withdrawals from the soil is not more rapid than the natural process of restoration.

When agriculture invades a region either in the first stage of settlement or after an interval of predominant pastoral industries, the productive capacity of the land is hastened, and crops or finished animals can be sold off the land more rapidly than the latter is able to renew its fertility unaided. If the process is continued, as it has been during the last 40 years in North and South America and elsewhere, without the addition of fertilisers or the maintenance of a fair number of permanent live-stock, the process of exhaustion, slow at first, becomes more and more rapid, and the law of diminishing returns operates actively. Every agricultural region throughout the world is threatened with this, unless proper limits are observed. Since live-stock in all but the more remote parts of overseas countries are now fed partly upon cereals or other crops drawn from the soil, it is clear that the output of animal foodstuffs is limited by the same conditions. Nevertheless the maintenance of a certain number of animals is recognised as an indirect means of keeping up soil fertility by providing for crop-rotation. The best results in this direction are obtained when the stock consist of dairy cattle,¹ and additional supplies of feedstuffs are purchased from elsewhere.² It has been found that certain exclusively grain-growing farms, such, for example, as are to be found in Western

¹ Professor Taylor, in his *Agricultural Economics* (p. 82), states that on a farm where butter and cheese only are sold, the loss of fertility is only one-tenth of that involved in selling a maize crop.

² If the maintenance of fertility is made to depend entirely upon the gains effected through purchasing feedstuffs from elsewhere, there can easily arise a vicious circle from the world point of view. In the end it would be robbing Peter to pay Paul, unless the feedstuffs are of tropical origin. Hence the significance of tropical oil-seeds and their products.

North America, have so far lost their original rich stores of fertility that the best means, in the absence of cheap fertilisers, of aiding in the work of restoration is to introduce live-stock farming in combination with cropping.¹ Thus, through the impetus given by diminishing fertility under a prevailing one-crop system, the advance of population and settlement leads to a sub-division of very large farms and a general transition to a more mixed type of farming with stock-rearing and dairying as prominent features. Some distinction needs to be drawn between horses kept for work, and food-producing animals. The former utilise a considerable part of the food they consume in the production of working energy, which, though it benefits the land by cultivation, disappears as a tangible product with the performance of the work. Horses are, of course, fairly numerous on pure crop farms, but they add little to soil fertility and the grain they consume must be regarded as a necessary deduction from the gross production. Meat and milk-producing animals, on the other hand, expend a small part of the total nourishment consumed in physical energy and a considerable amount in the production of proteids and fats. Indeed the aim of the science of breeding the various classes of these animals, whether cattle, sheep, or pigs, is to develop the capacity for converting feedstuffs into milk and meat at the expense of that expended as mere maintenance rations or in useless physical energy.

Not only cereal crops, but also cotton and linseed or flax, as now grown in various temperate and warm temperate regions, are apt to lead to soil exhaustion. Large quantities of cotton-seed and linseed, in addition to the fibres, are exported. In the majority of cotton and flax growing regions fertilisers are but little used, nor are domestic animals kept to any extent. Some of these regions, though originally rich, have become partially exhausted, and require treatment similar to that found necessary in the over-cropped cereal regions. It is significant that the United States Department of Agriculture is recommending farmers in the cotton belt to take up stock-farming for beef production and dairying purposes.

It is impossible to disregard the question of the supplies of fertilisers as affecting the production of human food, whether of animal or of vegetable origin. The maintenance of a high standard of production per unit of area must depend upon returning to the soil in some direct or indirect form an equivalent of the plant-food elements taken from it by crops or in other ways.

Viewed as a whole, agricultural lands throughout the world suffer loss of fertility in the following special ways: first, by the washing of soluble fertilising elements from the soil by drainage

¹ Experiments conducted at Rothamsted point to the conclusion that when land is continuously cropped in successive years without the addition of fertilisers, the yield falls rapidly in the first few years, but afterwards remains fairly constant at a low level.

This rate of yield would probably be unprofitable under ordinary practical farming conditions.

and by the transport of rich sediments to the sea, both of which may be considerable in regions subject to a heavy rainfall¹; second, through the physical energy expended by animals and human beings not used in the cultivation of the soil; third, by the disappearance of sewage material from towns into the sea or into large bodies of inland water²; fourth, by the loss of fertilising elements in returned manure and organic refuse through undue concentration and exposure to the air; and fifth, especially in new countries, by the destruction through fires of accumulated humus and of all except the mineral constituents of grasses and other vegetation.

Against those losses must be set certain gains: first, through the natural disintegration of rock material into soil and the action of bacteria in making the soil constituents available as plant food; second, through the natural accumulation of humus from the decay of wild flora; third, through the artificial and hastened accumulation of humus from the ploughing in of green crops; and fourth, through what reaches the land as fertilising material from the sea in the form of fish and fish refuse, and seaweed.

Under the more intensive methods of agriculture, even when the rearing and maintenance of live-stock constitutes an important part of the whole business, a deficit is apt to arise in soil fertility unless artificial fertilisers are used. These tend more and more to become the chief means of maintaining the balance of fertility in the more densely populated agricultural areas, and the supplies of them require, therefore, to be examined in some detail. The following table shows the world's output³ of the more important artificial fertilisers in the period preceding the year 1914 in millions of metric tons.⁴

	1906	1909	1912
Nitrate of soda	1·728	2·134	2·494
Sulphate of ammonia	·705	·896	1·230
Natural phosphates	4·131	5·155	6·886
Basic slag	2·660	3·028	4·001
Kainite	3·039	3·613	5·778
Totals	12·263	14·826	20·389

¹ Experiments conducted at Rothamsted show that the loss of soluble elements by seepage and drainage is often serious. With regard to soil erosion, it is said that 11 million acres of farm lands in the United States have been made valueless owing to this cause. In this connection, see also *Revue Economique Internationale*, Feb., 1912, pp. 391-407.

² An average adult annually excretes 12 lbs. of nitrogen, 7 lbs. of phosphoric acid, and 5 lbs. of potash, *Journal Board of Agriculture*, May, 1916, p. 129.

³ Not including stocks held in reserve.

⁴ The figures are those given by the International Agricultural Institute.

A study of the above figures makes it clear at once that there was a rapid advance in the output of all the items in the short period under review. Further, the by-products of industry, such as sulphate of ammonia and basic slag, already form an important part of the total, while those derived from sources liable to exhaustion, such as nitrate of soda and guano, constitute a much smaller fraction. The deposits of rock phosphates are known to be very large and many others exist besides those already worked.¹ There is not much doubt that the progress of industry will lead to a greatly increased production of fertilisers, independently of limited natural deposits, hitherto relied upon to a greater extent. Even potash deposits are not so limited in geographical distribution as formerly thought.²

Moreover, quite recently discoveries have been made which go far towards rendering the fixation of atmospheric nitrogen commercially possible. Prior to the year 1914 small quantities of nitrate of lime were produced in this way, chiefly in Norway, but since that year enormous strides have been made, particularly, it is stated, in Germany, in the production of artificial nitrates.³ It is probable also that in the future very much greater quantities of nitrogen constituents will be recovered from the coal consumed in the leading industrial countries.

The general conclusion concerning the supplies of fertilisers seems to be that not only is there no danger of a shortage in the future, but that large increases are to be expected, though not perhaps for some years after the close of the European War. Any marked increase in the use of fertilisers will undoubtedly benefit animal industries and the supplies of animal products, because in the scramble for the use of land between animals and cereals the latter are likely to have their needs satisfied first. Any rise in productivity following upon a more liberal and a wider use of fertilisers will tend to reduce the pressure upon the areas of agri-

¹ There are extensive deposits of rock phosphates in Northern Africa and in the United States now under contribution, in addition to others elsewhere not yet being worked. The easily accessible deposits of Florida are said to be practically inexhaustible, and are therefore likely to yield a rapidly increasing output.—U.S. Dept. Agric., Bureau of Soils, *Bulletin* 76, p. 22.

² In addition to the deposits of potash salts in central Germany and in Upper Alsace, deposits of potash-bearing minerals are known to exist in Catalonia in Spain, at Searle's Lake in California, in India, and in Australia. In the two latter countries, unfortunately, the potash occurs in the form of insoluble compounds.

³ Before the outbreak of the war Norway was the chief producer of synthetic nitrates, its exports in 1913 amounting to about 70,000 tons. The progress made in Germany in the manufacture of these products is shown by the fact that, whereas in 1914 but 60,000 tons of synthetic sulphate of ammonia were produced, by 1917 the estimated output of these products was 500,000 tons in addition to nearly 400,000 tons of cyanide. It is interesting to observe that steps are also being taken to produce synthetic nitrates in Great Britain and in the United States. When hostilities cease enormous quantities of these products, now used mainly for war purposes, will be available for agriculture.

cultural land and increase the resources available for the maintenance of food-animals.

Nevertheless, in spite of a probable large increase in the future supplies of fertilisers, there will necessarily remain large areas of the temperate regions distant from seaports and from centres of production of commercial fertilisers, where the cost of transport will make the utilisation of these materials more or less prohibitive. These regions are now largely devoted to the production of cereals or to pastures. As above described, the best means of exploitation open to such extensive areas is to combine the most suitable forms of stock-raising with crop cultivation, in view of threatened soil exhaustion. This will take place all the more readily since new cereal lands will probably be more easily found in the future than new pasture lands, owing to the encroachment of the former upon the latter.

It appears, therefore, that the progress of agricultural science, aiming always at maximum production, will favour some extension of animal-rearing in occupied temperate lands, whether of the high-farming type near centres of population or of the more remote cereal-producing type. Though it is not likely that the full effect of such progress will be felt for some years to come, changes in this direction are not likely to be long delayed. In the meantime the position has to be accepted as it exists, with a threatened shortage of animal foodstuffs.

The question of the supplies of fertilisers calls for close attention, especially in connection with the more intensive, high-farming methods common in Western Europe. Since in the past this region has drawn upon the newer countries for concentrated feed-stuffs and has thereby added to its soil fertility indirectly, it becomes necessary to inquire whether the latter countries are able to maintain their rate of crop-production without threatened loss of fertility. Otherwise the process would involve a transference of part of the world's capital in soil fertility from the newer crop-producing regions to the more intensive regions with predominant animal-rearing industries—a thing that cannot go on indefinitely without unlimited areas to draw upon.¹ If fertilisers can be supplied freely to these newer countries, the process may continue for a long time, theoretically, at all events. Here distance from seaports is an important determining factor, for cereals forwarded to a seaport will bear charges in freight that fertilisers returned in exchange may not. It is more probable that these inland regions in the newer countries, when once they have passed the stage of pioneering in agriculture, will tend to raise stock, and finish them with their surplus feedstuffs, as a means of preserving fertility, rather than continue to act as "hewers of wood and drawers of water" by exporting large quantities of feedstuffs and importing

¹ See p. 142 above, Note 2.

fertilisers to correct soil exhaustion.¹ In many cases, of course, owing to climatic conditions and the lack of capital and technical knowledge, this will be impossible for many years to come. The tendency, in any case, may well be towards greater specialisation in the higher-priced cereals for human consumption, wherever the rearing of live-stock is out of the question.

In the meantime, at any rate, there is no essential reason for a shortage of feedstuffs. Maize, oats and barley can be grown more profitably than wheat at the pre-war price levels in wide regions, and even under exclusive cereal cropping some rotation of grains with wheat is found advantageous, and potatoes may be grown more widely than at present as a stock feed in the colder intensive farming regions of the North Temperate Zone. Moreover, as has already been noted, enormously greater quantities of oil-cake from tropical oil-seeds are likely to be available for stock-consumption in the future, and this may cause a considerable net addition to the world-supplies of concentrated feedstuffs, even though other sources show some decline.

The carelessness and indifference of farmers with regard to the preservation of soil fertility in many parts of the world during the last three or four decades, may be ascribed to the extremely low prices for agricultural produce as sold from farms, till quite recently. It is not likely that prices will again fall so low for a long time to come, and there is therefore reason to believe that more constructive methods of agriculture will be found possible and profitable in the future. The fact that fertile new lands can no longer be so easily found to exploit, when occupied ones have been exhausted, may impose these methods as a necessity in the future, with beneficial results to animal industries, since they are the key to permanent intensive agriculture.²

¹ It is important to observe that if the introduction of animal industries into such regions causes a reduction in their surplus of concentrated feedstuffs, exported hitherto to the countries of Western Europe, to that extent there will be no gain to the production of animal foodstuffs throughout the world as a whole.

² During the 19th century the fertility of the soil has suffered in many parts of the world, especially in the newer countries, owing to the institution of private ownership and of private capital in land which has demanded a short-time return. Though corporate ownership would probably lead to a more far-sighted policy, the time seems very distant when such a system will be generally adopted. See also next chapter.

CHAPTER IX

THE SUPPLIES OF CAPITAL

THE detailed survey of the various surplus-producing areas made in Chapters IV. and V., above, served to show the necessity for capital outlays for the proper development of all the newer regions, whether temperate or tropical. Till the present time share capital has been available for the construction of such permanent undertakings as railways and freezing works and the establishment of shipping lines, but seldom for the purposes of ordinary agricultural production. As compared with mining and industrial enterprises, agricultural industries have been a neglected field for investment. They have been at a disadvantage in attracting capital, because hitherto the system of isolated private enterprises has held full sway. It is to be noted in this connection that a much greater outlay of capital above the cost of the land is required for stock-rearing than for simple crop-production.

Recently, however, a start has been made in Brazil and other tropical highlands, in organising cattle-rearing on a large scale under company management, to supply an export trade. This movement promises to develop in the future, as the whole industry is essentially one where modern methods of stock-raising under expert management, backed up by proper lines of communication and coastal freezing works, will yield returns sufficient to encourage investment. The future development of the pastoral resources of the tropical highlands throughout the world lies more in this direction, as has been previously noted, than in the system of private and individual exploitation. In view of the possible shortage of capital in Europe for foreign investment after the close of the War, it is possible that the capital for such enterprises will come largely from North America ; this will all the more be the case, since the technical side of cattle-raising and of meat-production on a large scale in tropical highlands has hitherto received most attention from American syndicates.

Capital expenditure is also required for the further development of animal industries in settled countries, whether densely or sparsely populated. Some company enterprises have started freezing works and meat-preserving plants, and butter and cheese factories, but these efforts have not extended very far. Much has still to be done in providing machinery, buildings, transport facilities, and buying and selling agencies. At the present time, however, share-capital will scarcely be invested in such undertakings, and still less in direct agricultural production, while many other more desirable fields remain open. The main effective alternatives are co-operation and State assistance.

The former has been applied successfully in the meat-producing and dairying industries of several countries, such as Denmark, Germany and New Zealand. Agricultural co-operative societies, by cheapening production and furnishing credit to their members, tend to acquire the strength and stability of a large share-company. Agricultural co-operation is encouraged by governments and other agencies that are interested in the progress of agricultural industries in their respective countries. Unfortunately, however, "generally speaking, farmers will not successfully co-operate until their position becomes unbearable,"¹ at any rate, in English-speaking countries. Nevertheless, if the results achieved already in a few notable instances may be taken as a guide, it may be concluded that great advances will be made in the future in all the more intensive branches of farming and especially in animal industries, under the stimulus of co-operation. The most striking form of co-operative enterprise consists in the supply of credit, equivalent in many instances to advances for capital outlays.² The advances in this direction are likely to be greatest in the more densely populated countries of European population, where also the consumption of animal foodstuffs is greatest.

Government assistance, generally involving capital outlays, has made rapid strides in the more advanced agricultural countries in recent times, especially since the close of the 19th century. Apart from tariff legislation, which shows a more or less general tendency to withdraw protection from producers of animal foodstuffs, governments have found various means of assisting agricultural production, particularly on the side of animal rearing.

Some of the more important of these are the establishment of agricultural colleges, the introduction of pedigree stock, the provision of staffs of veterinary surgeons and of expert advisers for stock-breeders, dairymen and poultry farmers, subsidies to agricultural co-operative and credit societies, systematic efforts in eradicating animal diseases, the grading of produce for export, and the construction of railways and other means of transporting and handling produce, worked at specially reduced charges in favour of agricultural producers. Some of the newer predominantly agricultural countries are more advanced in these forms of state subventions than the industrial countries of Western Europe.

The growth of such forms of government activity, superseding in some measure the protective tariff measures of the 19th century, is to be regarded as leading to an increased general yield of foodstuffs in proportion to the occupied area, and cannot fail to have a favourable effect by encouraging the spread of the more inten-

¹ U.S. Yearbook of Agriculture, 1914, p. 191.

² Very complete information concerning the progress of agricultural credit societies in many countries are given in the monthly *Bulletins of Social and Economic Intelligence*, published by the International Agricultural Institute.

Compare also the voluminous report of the American Commission in Europe, Senate Documents, No. 214, Agric. Co-operation and Credit in Europe.

sive forms of animal industries. Though the various states do not thereby become direct shareholders in agriculture, they nevertheless reap indirectly an ample reward in the increased prosperity of that industry which is the leading one in all countries.¹

¹ Even in the United Kingdom the Census of Production of 1907 shows that the net output of the agricultural industry is greater than that of any other single group of industries.—See *Oxford Survey of the British Empire*, Vol. I., p. 221.

CHAPTER X

AGRICULTURAL MACHINERY IN RELATION TO THE PRODUCTION OF ANIMAL FOODSTUFFS

THE extent to which labour-saving machinery can be used in the production of foodstuffs, especially those of animal origin, is of the greatest importance, in view of the relatively high labour cost of these products. Moreover, in certain new countries, it appears that the shortage of farm labour arising from the sparse population actually keeps production below the level possible from the resources of occupied land.

Whether the large industrialised farm will become general in the future is a doubtful question. Certainly on such farms machinery could be used more effectively than is the case on the ordinary private farm; but it does not seem likely that rapid changes will be made in the direction of organising such undertakings in the near future.

In considering the production of animal foodstuffs it will be recognised that the application of machinery to crop-cultivation has a favourable effect in two ways, first, by making the production of cereals for human consumption easier and cheaper, and thereby leaving more energies and resources available for animal-raising; and second, by making the supplies of animal feedstuffs and fodders cheaper and more abundant. Moreover, so far as steam or motor power is used for land cultivation, a corresponding number of horses can be dispensed with, and the feed materials they consume be devoted to raising food-animals.

In animal industries pure and simple, the introduction of machinery has not proceeded far towards relieving human labour, except in treating the products. The rearing of food-producing animals still requires considerable human care and skill.¹ In stall-feeding some machinery is effectively used in preparing and weighing the feed materials, and in dairying milking machines are now in use, but by no means generally so.

The greatest recent advances in the utilisation of machinery in animal industries are connected with the handling of meat animals and meat products in freezing works and during storage and transport, and with the treatment of milk in butter and cheese factories. Both these developments have resulted in a great saving of human labour and in a greater transportability of perishable animal foodstuffs. The separator, in particular, has greatly reduced the labour required in the production of butter and has at the same

¹ It has been observed that a relative decline in the agricultural population of a given area is possible with the more extended use of machinery, "but the query is raised whether this rule applies in the same degree to meat-animal production."—U.S. Dept. Agric. Bureau of Crop Estimates Report 109, p. 22.

time improved the quality of the product.¹ However, it is doubtful whether the same proportion of the total output of milk in the leading dairying countries will continue to be devoted to butter-making in the future, for reasons that are given in dealing with consumption below.²

The milking machine is likely to be improved in the near future, beyond the experimental stage. Evidence from various countries shows that this machine is already of practical utility since it has been worked with satisfactory results for periods long enough to form effective tests.³ The probability is that before many years are past it will become part of the ordinary equipment of dairy farms, wherever hand labour is scarce or costly. Its effects upon the dairying industry will almost certainly be of a revolutionary nature, especially in new countries where the cost of milking alone often amounts to over one-third of the value of the milk produced. In the event of the milking machine being introduced in the near future, the result would be to give dairying special encouragement as compared with other branches of animal industries. It is probable that margarine will be used increasingly as a substitute for butter and animal fats in the future, but even margarine requires a certain amount of milk (upwards of 30% by weight of the raw materials) for its manufacture; and cheese, whole milk and the condensed and dessicated forms of milk are likely to become more important articles of food among town populations if there is any shortage in the supplies of meat. Dairying in any case is an industry well suited to the more intensive type of farming, which seems destined to develop considerably in the more advanced agricultural countries.⁴

On the whole, while the use of machinery has greatly reduced the labour costs in the production of cereals and other crops, thereby

¹ The general increase in dairying, as compared with other forms of animal industries in a number of countries in recent years, while due largely, no doubt, to the increased demand for dairy products, has been facilitated by developments on the side of production, such as the application of machinery to the production of butter and cheese, the rapid spread of co-operation, the standardisation of products, and the marked improvements in the milk-yield of cows.

² See Part II., Chap. ii., pp. 212-214.

³ For descriptions of milking machine tests and their results, see the following publications:—

U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin* 92 (1907).

Wisconsin Univ. Agric. Station, *Bulletin* 173 (1909).

U.S. Dept. Agric., *Bulletin* 423 (1916).

U.S. Dept. Agric. *State Expt. Station Bulletins*, Kent, No. 186; Geneva, No. 317.

Deutsche Landw. Gesellschaft, *Arbeiten*, Heft 254 (1914).

Annales de la Science Agronomique, 1914, pp. 84-97.

For the progress made in the adoption of milking machines in Australia and New Zealand see the Handbook for Australia, 1914, p. 398, (British Association for the Advancement of Science) and the Dominions Commission's Minutes of Evidence taken in New Zealand, Q. 2686.

⁴ For a discussion of this point see H. Levy, *Large and Small Holdings* Chap. ix.

indirectly assisting the progress of animal industries, it appears doubtful whether machinery (except as described above) will be of much further direct service in these industries. Indeed, the process of intensification upon which an increased future production largely depends, involves greater human care in the handling of the more highly specialised animals.

Closely connected with the question of the utilisation of machinery in the service of animal industries, is that of the density of agricultural population which determines largely whether the extensive or the intensive system is followed. Obviously in those regions where the agricultural population is sparse and labour is scarce, only those types of food production can be followed that utilise machinery on a large scale, such as cereal cropping, or that make little demands upon labour in any form, such as large-scale cattle-ranching on natural pastures. Mixed farming and all forms of animal industries, except the purely pastoral, make considerable demands for labour and require a certain minimum density of population in consequence; but clearly also, the more machinery can be used in mixed farming and ordinary animal industries, the lower may be the density of agricultural population for the effective production of foodstuffs.

Owing to the increased demand throughout the world for cereals and other products, there is a tendency for animal industries to leave the open prairie or steppe, which, as above explained, is in some ways better suited to grain crops,¹ and to remain or to return only to such an extent as the preservation of soil fertility demands.² A survey of the world's producing areas shows that most of the large pasture regions in the temperate zones are already occupied, and animal industries are therefore thrown back on one of two ways of increasing their output, both of which involve a considerable amount of human labour. The first of these is by the application of more intensive methods on land already in use, and the second is by clearing forest lands for pastures, a process which is still in progress in a number of the newer countries. This process, however, is limited by the necessity of preserving timber supplies and by the comparative low productivity of much of the land remaining to be cleared.³ The labour involved in clearing is often great, and a long time must often elapse before production becomes effective.

Owing to the labour question, the lands now being taken up, and likely to be taken up in the near future in the temperate regions, are often more favourable initially to cereal cultivation

¹ See Chap. iv., above, p 87.

² The rising price of land has in some cases in the prairie lands of North America made it necessary to substitute mixed farming with dairying and pig-rearing, for the one-crop system, in order to secure an adequate return.

³ In spite of the large areas still under forest in the temperate regions, it is doubtful whether any large effective additions will in future be made from them to pastoral or agricultural lands (see Chap. xi., below). In any case forests often cover mountainous, swampy and unduly cold areas that are of little agricultural value.

than to stock-raising, since these lands have small productive power when devoted to purely pastoral industries. The regions of more equable climatic conditions are already largely occupied. The leading factor here has been already referred to; wheat and other cereals require about four months of favourable weather conditions,¹ while farm animals without considerable outlay in equipment, etc., require freedom from climatic extremes during the whole year for the successful production of foodstuffs.² In these remaining regions the average cereal yields may never be great, owing to the poorness of the soil and the climatic disabilities, but the application of labour-saving machinery in cultivation and harvesting may nevertheless enable a margin of profit to arise from cereals. Machinery, however, has no place in the ranching type of animal industries and very little in the more intensive forms. In short, new cereal lands are for the present more abundant than new pastoral lands of such a quality as to produce more than wool and the lower grades of meat. A greater density of population is required to enable animal-rearing industries to proceed beyond the ranching system, and an increasing density of agricultural population is required as these industries become intensive. Now it has been noted that in the production of cattle and sheep the pastoral system, pure and simple, without the cultivation of some crops for the maintenance and fattening of the animals, is becoming a thing of the past. This is owing to the scarcity of land and the low yield of meat per acre under this system. A revival of the older type may take place with the development of tropical highlands in the future, but this will hardly affect the trend of development in temperate lands.

It would appear from evidence collected in Australia,³ New Zealand,⁴ Canada,⁵ Siberia,⁶ and South America,⁷ that once the purely pastoral stage is over, increases in the production of meat, and still more of dairy products, await an increase in the agricultural population. In the present stage of development of the

¹ See Unstead, "Climatic Limits of Wheat Cultivation, with Special Reference to North America."—*Geog. Journal*, April, 1912.

² Moreover, the world's demand for cereals, especially wheat, is more inelastic. Owing to their keeping qualities as compared with animal foodstuffs, cereals can be stored cheaply and transported at leisure—an important consideration in remote districts. Cereals can even be held over in part from one season to another, whereas animals often cannot profitably be held over for slaughter from one fattening season (*i.e.*, of summer pastures) to the next. In new countries cereal cultivation is perhaps the only important industry where enterprising men can start without capital; the initial outlay is small; the returns rapid; and much less care, technical knowledge and social co-operation are required than for animal industries except of the ranching type.

³ Dominions Commission, Minutes of Evidence, Australia, QQ. 8130–8138.

⁴ Dominions Commission, Minutes of Evidence, New Zealand, Evidence of Clifton, Marshall, Edwin Hall, and others.

⁵ Canadian Sessional Papers, Vol. IX., 1913.

⁶ F. Nansen, *Through Siberia*, pp. 282–303.

⁷ *Cf.* the constant complaints of a labour shortage in Argentina.

science of animal husbandry and of technical equipment, there exists a certain optimum density of population, varying with the geographical and economic conditions of each region, in order to secure the maximum surplus production of animal foodstuffs.¹ When that optimum is passed, as seems to be now the case in the United States, the increased population begins to trench upon the surplus. On the other hand, below the optimum, each increase in the population leads to a greater proportionate increase in the product, and hence also in the exportable surplus, since when the population is very small and the animal industries of the country quite undeveloped, the surplus is nil. Various factors complicate the determination of this optimum for new countries, notably the proportion of waste land, the suitability of the whole country for animal rearing, and the extent to which competitive cereal and fibre crops are grown for export in excess of home requirements. The great animal-raising regions of the world (exclusive of the tropical highlands, as yet scarcely developed) lie between 30° and 60° from the Equator. Medium land under average climatic conditions in these belts will maintain one head of cattle to about 3 acres or 1½ to 2 sheep per acre all the year round, provided hay and some fodder crops are grown for winter use.² The optimum density of population for the maximum surplus of animal foodstuffs under existing conditions seems to be between 10 and 20 persons per square mile. Wherever such conditions as a high

¹ Cf. Max Sering, *Landwirtschaftliche Konkurrenz Nordamerikas*, 1887, p. 609: "... the number of cattle per square kilometre rises to a certain limit with the increasing density of the population ... it grows with the number of the producers and the more complete methods of exploitation till the time when all the suitable land is occupied and brought into use. Conversely the production of cattle per head of the population will be greatest when the process of settlement is in its earlier stages ... the number of cattle per capita will gradually decline after a certain point, because ... the pasture lands available for the herds will be reduced in area by crop cultivation."

This, however, does not allow for the increases in the numbers of live-stock due to the introduction of modern intensive methods as they exist in the elaborating-commercial countries.

On the plains of both North and South America the trend of development seems to be from ranching pure and simple to cereal cultivation, and thence to mixed farming. The curve of the number of live-stock per square mile shows a downward movement from the first stage to the second, followed by an upward movement in the third stage. The per capita curve may or may not show an upward movement in this last stage.

² The carrying capacity of English grazing land is said to be one bullock for every 3 acres on an average the whole year round.—C. Middleton in evidence before a Royal Commission (Cd. 2644), QQ. 8157-9.

³ The Argentine alfalfa pastures will carry one steer to 2½ acres in general and one to 3½ acres for fattening.—U.S. Dept. Agric. Year Book, 1913, p. 357. The distant natural pastures in Argentina carry one head of cattle to 6 acres or one head of sheep per acre.—U.S. Dept. Agric., Bureau of Animal Industry' *Bulletin* 48, p. 55.

The average carrying capacity of New Zealand land is one head of cattle to 2 acres with fodder crops. Dominions Commission (Cd. 7170) Q. 2686. The permanent pastures in the same country are expected to carry 1½ to 3 sheep per acre.—U.S. Daily Commerce Reports, Aug. 14th, 1911, p. 69.

proportion of waste land, a general unsuitability to animal industries, or a large export trade in cereals and other crops, exist so as to hinder the maximum development of stock-rearing, the optimum may fall towards 10 persons per square mile, and in some cases even lower. This calculation is based on the supposition that the proportion of mining, industrial and other town population to the agricultural population is not above the average. The densities of population in some of the more striking of the newer countries are as follows:—Argentina, 7 per square mile; Australia, 1·7; Canada, 2·2; New Zealand, 12; Western Siberia, 4; United States, 34. In the case of Australia, Canada and Western Siberia, there are extensive areas of uninhabitable deserts or frozen wastes. An examination of the above figures shows that the United States is now well above the optimum range suggested above. A comparison between the density of population in that country and its exports of animal foodstuffs indicates that the latter were greatest when the former stood between 20 and 25. The United States constitutes an exceptional case, because the average fertility of the soil has been high and the methods of exploitation very effective. None of the other regions taken above has as yet reached the optimum range, except New Zealand, which again is exceptional, owing to its great suitability for, and its great specialisation in animal industries. For New Zealand the optimum is probably 20, or even more, persons per square mile, while that for Australia, Canada and Western Siberia is probably not much above 10, unless a much greater share of the energies of the respective populations is devoted to animal industries than at present.

Any marked progress beyond the existing stage in the application of intensive methods, such as a more extensive cultivation of fodder crops, the use of fertilisers (imported, if necessary), improvements in the breeds of stock, and the spread of co-operative methods of production, will tend to raise the optimum density of population in the connection under study. Under this head, also, must be classed any increase in the net imports of feedstuffs that cannot readily be grown locally. Strictly speaking, some deduction should be made for these imports in determining net exports of animal foodstuffs, since the existence of such imports really means that for animal-rearing purposes the area of the country is practically extended by the acreage devoted to their production in the supplying countries. On the other hand, any reduction in the proportion of "ready-money" crops in the exports of the newer countries, may cause the release of land in them for animal industries and thereby lead to a raising of the optimum level of population.

NOTE TO CHAPTER X.

It is convenient to take 11b of meat as equivalent to 11b of cheese and to ½lb. of butter. This equation represents with sufficient accuracy the average pre-war proportion of money values, and makes it possible to reduce the exports of these three principal items of animal foodstuffs to a common denominator for the purpose of comparison between different countries.

CHAPTER XI

USES OF LAND COMPETITIVE WITH ANIMAL INDUSTRIES

IN view of the existing limitations upon the area of agricultural land throughout the temperate regions of the world, it is necessary to consider the extent and nature of the competition for the utilisation of land arising from the demand for various vegetable products, such as cereals and other food crops, fibres and certain other raw materials for manufacture, and timber. The extent to which animal industries can be developed in the future obviously depends upon two main factors, namely, the total amount of land available for the maintenance of the animals, and the degree of intensification; the first of these depends largely in its turn upon the areas of productive land left unclaimed, when the minimum necessary output of the above-mentioned materials for direct human consumption or for manufacturing purposes has been secured. It is proposed to deal with each of the different competing uses separately.

(a) WHEAT AND RYE.

These two cereals, which are confined to the temperate regions, are grown pre-eminently for human consumption. In Northern and Central Europe, from a statistical point of view, wheat plus rye forms a composite cereal, the consumption of which has a fairly constant per capita ratio. The world's requirements in wheat and rye together tend to be proportional to the increases in the consuming population from year to year.¹

The demand for these cereals is much less elastic than that for animal foodstuffs, and insists upon being satisfied first. Animal industries must therefore retire if the cultivation of wheat and rye exerts pressure upon the area of productive land, unless these industries can adapt themselves so as to be followed intensively in combination with the cultivation of the prime cereals.

¹ Differences and fluctuations in the per capita consumption of wheat plus rye, appear, as might be anticipated, to vary inversely with that of animal foodstuffs. Thus the German peasant consumes more cereals than the German townsman, and the per capita wheat consumption in the United States has risen during the last 50 years with the decline in the per capita meat consumption.

The increase in general prosperity during the period 1901-1911 was reflected in a rise in the rate of wheat consumption. During that period, according to Rew's estimate (Cd. 7271, p. 377), the per capita wheat acreage in the consuming world rose from .28 acres to .31 acres, and there was also a slight increase in the average yield.

The following table shows the estimated total yield of wheat and rye throughout the world in different years (in millions of Winchester bushels) :—

	WHEAT	RYE	TOTAL WHEAT AND RYE
1895	2,593	1,468	4,061
1900	2,641	1,558	4,199
1912	3,792	1,892	5,684

In the seventeen years under review the increase in the total yield of wheat and rye together amounted to about 40%, but it is noteworthy that the greater part of this increase took place after the year 1900.

→ Only a small proportion of the wheat and rye produced the world over, is now fed to animals,¹ but the milling offals, which amount to about $\frac{1}{4}$ of the grain as taken to the mills, are fed almost entirely to food-animals which get also the spent grain which arises from the use of certain quantities of rye in distilleries. On the whole, however, even when allowance is made for the limited value of the straw as fodder, land under wheat and rye is devoted mainly to the production of human food, and other things being equal, any extension of the area so utilised throughout the world will be a competing force with animal industries.²

(b) OTHER CEREALS.

Of the other cereals grown in the temperate regions, barley is consumed directly as human food in an appreciable proportion, and in addition, of course, great quantities are used in the brewing industry. Barley is used extensively as an article of human food in Japan, Western Asia, Northern Africa and Northern Europe. In Central and Western Europe, as well as in North America, barley is grown more especially for brewing purposes, though the by-product known as brewers' grains, amounting to about 25% by weight of the original barley,³ forms a valuable feedstuff material for cattle. In the period 1909-13, about 56% of the total supplies of barley available from home and foreign sources in the United Kingdom, was used in breweries, and of the remaining 44%, about

¹ The consumption of waste, inferior and damaged wheat by poultry is perhaps the most notable example of the regular use of this grain as such as a feedstuff.

² See U.S. Dept. Agric. Yearbook, 1909, pp. 259-272 for some estimate concerning the future production and consumption of wheat in the world.

³ This is the proportion of dried brewers' grains to barley by weight, calculated from the figures given by a Committee of the Royal Society in their Report (Cd. 8421), p. 30.

38% was available as animal feedstuffs.¹ If the dried brewers' grains are taken as equivalent in feed-value to barley weight for weight, it would appear that during the years 1909-13, about 52% of the total supplies of barley in the United Kingdom was fed to animals directly and indirectly. The proportion of the supplies consumed as human food, exclusive of that used in the manufacture of beer, was very low, standing at less than 2% in the period taken.¹ The proportion of the barley supplies used as animal feedstuffs throughout the Continent of Europe and in North America would seem to be at least as high as that in the United Kingdom; it is probably higher because greater quantities are available at farm prices than in the United Kingdom. In Asia and Northern Africa the proportion of the barley supplies used as human food is apparently quite high and the proportion fed directly to animals correspondingly low. However, according to the available figures, less than 10% of the world's crop is grown in these regions. On the whole, therefore, as long as the crop is disposed of in the pre-war manner, any extension in the cultivation of barley, at any rate, in regions populated by Europeans, will be somewhat favourable on the balance to animal industries; the more so since, as in the case of wheat and rye, the greater part of the straw is available as fodder wherever food-animals are reared.

For the production of wheat and barley it is possible that hitherto unutilised areas may be added by means of dry-farming and irrigation in North and South America and Australia. American authorities are doubtful as to the prospects of profitable cereal cultivation on lands reclaimed by these methods, but seem more hopeful that such cultivation will prove remunerative, if combined with animal-rearing.² In this case a larger proportion of the barley produced might be fed to animals on the spot. In both the Northern and the Southern Hemispheres recent experience shows that the cultivation of wheat and of barley tends to invade the colder sheep lands with specialisation in rapidly maturing species, rather than the warmer and moister regions towards the tropics where cotton, maize and other special crops compete with live-stock in the occupation of the land.

Maize is also consumed in appreciable quantities directly by human beings; and industrial uses such, for example, as in the production of starch, glucose and spirits, account for another appreciable fraction of the crop sold off farms. In the United States, which produces on an average about three-quarters of the world's maize, less than one-tenth is used directly as human food, while in Argentina, which ranks next, scarcely any is so consumed. Some other countries, notably Italy and Mexico, use nearly the

¹ The percentages have been calculated from figures given in Prof. Wood's publication, *The National Food Supply in Peace and War*, p. 17.

² See U.S. Dept. Agric. Year Book, 1912, pp. 463-471. Cf. also Max Augustin, *Die Entwicklung der Landwirtschaft in den Vereinigten Staaten*, 1914, pp. 130-7, and J. Russell Smith *Industry and Commerce* 1916, p. 55.

whole of the local crop for human food. Taking the world as a whole, probably less than one-tenth is consumed as human food. Allowing 10% for seed and wastage and another 10% for industrial uses, there would remain over 70% of the whole annual production available for animal feeding, but of this a certain proportion, not however, very great, is fed to power animals. Probably about 60% of the whole world-crop is generally available as concentrated feed-stuffs for cattle and pigs, that is, for meat production. Obviously, therefore, any increase in maize production, under the present methods of disposing of the crop, favours animal-rearing industries.

Oats are grown mainly for horses. In agricultural regions, therefore, they are essentially a power-feedstuff, and the land devoted to their cultivation should be deducted from the gross area available for cultivation as a premium necessary to secure horse-power for the cultivation of the rest.¹ A small proportion of the world's oats crop, amounting to about 5%, is used for human food, and a larger, though not any considerable proportion, for feeding to meat-producing animals. More, apparently, is used for this latter purpose in Europe than elsewhere. In view of these conditions, any extension in the production of oats throughout the world cannot be regarded as favourable to meat-producing animal industries, unless this extension enables a greater proportion to be fed to farm animals other than horses. It is interesting to note that the world's oats crop increased according to estimates made, from 3,008 million American bushels in 1895 to 4,672 million American bushels in 1913, that is, more than 50% in eighteen years.

It is difficult to summarise in precise terms the facts concerning the competition offered by cereal cultivation in temperate regions with animal industries in the same regions. Much depends upon the degree of intensification. Under the simple forms of these two main agricultural industries as practised in newly-developed regions, the competition between them for land seems most obvious, since land taken for cereals can no longer remain free to support pastures; but even in those regions it is well known that considerable areas of land are not producing to their full capacity, while occupied for one of these purposes alone, and that the introduction of the other industry in combination with that already established, by utilising more intensive methods, may so far increase total production as to leave the original output of the former more or less unaltered. Moreover, it is quite possible that even when food-animals obtain only a part of a cereal crop, such as barley, grown on a given area of land, the return in feed values may be greater than if the same land were to remain under pasture. Thus a moderate amount of crop cultivation, introduced into a region formerly devoted to raising stock on natural pastures, may not cause any reduction in the number of stock carried, while allowing some margin of grain for sale. In this connection the part played

¹ For a discussion of the effects of the substitution of motor-power for horse-power in agricultural operations, see Part II., Chap. v, below, pp. 259, 260.

by poultry, as described elsewhere, in the world's supplies of animal foodstuffs, should be borne in mind. Since poultry are largely fed, especially in the chief cereal regions, on the less marketable grades of wheat, barley and maize, their products form an important contribution to the supplies of animal foodstuffs, as soon as cereal cultivation appears.

It seems, therefore, that within certain limits, the competition between cereals and food-producing animals for the occupation of land depends more on the methods of utilising the land than upon the extent to which the former are introduced. It is not surprising that this competition should have been felt most in the United States, because there the customary methods of agriculture have been least intensive, but it is significant that American agricultural authorities are convinced that a change of methods could lead to an enormously increased production of animals, while maintaining the necessary level of crop-production. Beyond certain limits, however, it is impossible to increase on a restricted area either the production of food crops or the rearing of animals without sacrificing the other in some measure, unless raw materials, such as feedstuffs and fertilisers are imported heavily. In point of fact, many of the countries of Western Europe have, during the last three decades, given animal industries an increasing preference to the production of wheat.

It is fairly clear in the main that the rapid increase in the white populations of the world and the general advance in the standards of living¹ have caused serious competition to arise temporarily at any rate between food crops and food-producing animals, though the food crops are not altogether confined to cereals such as wheat and rye. This competition tends to be accentuated by the growing demand for fibres and for timber, both of which, however, for reasons of economy, are likely to be produced more and more under cultivation rather than by the uncontrolled forces of nature.

The rapid increase in the area cultivated has involved a corresponding increase in the production of oats and other feedstuffs for horses, which will continue unless power-driven agricultural machinery comes more widely into use. This, however, appears quite likely. It is indeed possible that the application of motor-power to such machinery will be sufficiently rapid in the near future to make a reduction possible in the quantities of horse feedstuffs grown throughout the world. In any case, the present rapid development of motor traction for vehicles in the agricultural districts as well as in the towns, seems likely to have an effect in this direction, and is therefore indirectly favourable to animal-

¹ There has been some tendency to substitute wheat for rye, barley and even rice as an article of food in different parts of the world, so that the number of wheat-eaters has increased faster than the world's white population. Thus the competition above described has been further increased, since wheat, owing to its somewhat lighter yield and its more exacting requirements in soil and climate, makes greater demands upon the world's temperate agricultural resources than these other cereals.

rearing industries by releasing for their use feedstuffs otherwise consumed by horses, or what comes to the same thing, by setting land previously devoted to horse feedstuffs free for the production of crops suitable for food-producing animals,¹ or for cereals for human consumption.

The comparatively rapid increase in the area devoted to wheat and rye in the leading producing countries has been made mainly in response to demands for direct human consumption, though poultry may have benefited incidentally also thereby. The process has often involved the breaking up of possible or actual pasture lands, and animal-rearing industries have in some measure been driven elsewhere. The increase in the cultivation of maize and of barley has also been considerable, but, as has been shown, the increase in the areas under these crops has not been unfavourable to animal industries on the whole, rather the reverse.² When the five leading cereals of the temperate regions are considered together, it seems almost certain that on the balance, food-producing animal industries have lost rather than gained by their increased production during the last twenty-five years.

Should the recent increase in the production of these cereals be maintained in the near future, the extent to which animal industries will be affected in competition will depend upon first, the proportion of the total output utilised directly or indirectly as feedstuffs; second, the average rate of the yield, and therefore the area occupied by these cereals; third, the extent to which advanced intensive methods of mixed farming are practised, enabling both cereals and animals to be produced under rotation cropping; and fourth, the extent to which additional feedstuffs can be drawn from tropical countries.

As an illustration of the tendencies and the possible future developments, the example of the United States may once more be quoted. That region has seen the most rapid agricultural development known in the world, and a kind of cycle is already observable. What were once remote western grazing districts were taken for cereal crops till soil exhaustion was threatened. Then, food animals once more became important under a more mixed type of farming. Similarly also, the early-time cereal districts of the eastern section, after being cropped extensively, were more or less abandoned, till with the increase in stock-raising and especially of dairying, and with improvements in the means of transport, making the use of fertilisers and commercial feedstuffs more widely possible, they have in some measure regained their strength, and are once more considerable producers of crops, though now under a more careful and better planned system.

¹ A calculation based upon data given in *Farmers' Bulletin* 459 of the U.S. Dept. of Agric. shows that in terms of the feed values consumed a day's heavy work from a small horse is roughly equivalent to 2 gallons of milk from a cow of about the same weight.

² The obvious result has been to favour an increase in pigs at the expense of pasture-fed animals, especially sheep.

It has been pointed out above that an increase in the crop yields per acre relieves the tax upon the area of productive land. The following table shows that improvements have recently taken place in the yields throughout the world of the two more important cereals not available directly for food animals.

AVERAGE PRODUCTION OF WHEAT AND OF OATS IN BUSHELS PER ACRE FOR THE YEARS 1905-9 AND THE YEARS 1910-14 IN THE WORLD AND IN SOME OF THE LEADING COUNTRIES.¹

	1905-9		1910-14		INCREASE	
	Wheat	Oats	Wheat	Oats	Wheat	Oats
World	13.8	30.2	14.1	31.4	.3	1.2
Argentina	10.8	29.4	9.8	22.7	-1.0	-6.7 ²
Canada	19.8	37.2	18.8	37.5	-1.0	.3
Germany.....	30.0	54.0	32.0	54.3	2.0	.3
Russia	9.5	20.2	10.4	21.8	.9	1.6
United States	14.9	28.6	15	30.5	.1	1.9

In the onward march of cereal cultivation in the leading countries, including especially those of Central and Eastern Europe, striking changes have taken place in the character of the animal industries. As will be shown later, it is the nomad sheep that has suffered most in the process.

(c) POTATOES.

The world's total area under potato crops, which are grown chiefly in Europe and North America, has increased considerably in recent years, having risen from about 34 million acres in 1905 to over 37 million acres in 1912, for which year the total production has been estimated at nearly 100 million tons. From the present point of view, the interest in potato cultivation lies especially in the extent to which the crop is fed to food-animals in various countries. In human diet potatoes act largely as a substitute for other starchy foods, of which they produce on an average a considerably greater quantity per acre cultivated than cereals do.³

¹ The figures are those published by the Internat. Agric. Inst., converted from quintals per hectare to bushels per acre.

² Decrease due to droughts and crop failure in 1910 and 1911.

³ The weight of the potato crop per acre is normally at least seven times that of the wheat (exclusive of straw) produced under the same conditions, but the former contain more water. The percentage of dry matter in wheat is at least four times as great by weight as that in potatoes, and the dry matter in the former has a higher nutrition value per unit.

In earlier times the masses of the European population lived mainly upon coarse whole-meal bread. The modern practice of refining flour so as to retain the starchy elements only, or of using potatoes partly in lieu of bread, neces-

Germany represents the extreme case of a country that normally grows potatoes in excess of the requirements of direct human consumption. It is estimated that in that country only about 27% of the annual crop is usually consumed as human food, while about 38% is fed to live stock.¹ Pigs are commonly fattened on potatoes in Germany, just as they are on imported feedstuffs in Denmark, and on maize in North America. In all important potato-growing countries, however, some part of the crop, consisting of the inferior grades, is fed to stock in all years, and a larger part in years of abundant harvests. The high average yield in weight per acre of potatoes may be regarded as causing any extension in the cultivation of potatoes to be somewhat favourable to animal industries; directly by furnishing a valuable fattening material in the surplus crop, and indirectly by reducing the area in particular countries and throughout the world, that requires to be assigned to the prime cereals in order to supply starchy foodstuffs for human consumption.

It is to be noted that, owing to their normal low value in proportion to bulk, potatoes do not usually, except in special cases, enter into international trade, so that each country depends largely for its supplies upon local production. By the principle of substitution, therefore, a small potato harvest in any particular country in a given year will tend to cause larger imports of cereals and concentrated feedstuffs into that country.

In one way, however, potato cultivation in recent years has resulted in direct competition with the production of human food supplies and therefore also with animal industries. Large quantities of the German potato crop in particular, previous to the year 1914, were used for the manufacture of starch and industrial alcohol. Though these industries have not developed to any great extent in other countries, they grew rapidly in Germany with the increase in the world's demand for the above products, and there is a distinct possibility that in the near future a larger proportion of the world's potato crop will be consumed in these ways.

Unless such commercial uses of potatoes increase enormously in the near future, it appears that in view of the ratio of consuming population to food-producing land, actual and possible, any increase in the cultivation of potatoes in those countries adapted to the crop would have a favourable effect upon the production of animal foodstuffs, especially of fats.

(d) SUGAR BEET.

This crop has risen to a place of marked importance during the last fifty years in a rich agricultural belt of Europe extending

sitates the extensive addition of protein, chiefly in the form of meats, milk and cheese, to complete the dietary. The proteid by-products of milling are fed to animals and poultry, and are thus consumed later in more acceptable forms, though not without considerable loss of food values.

¹ From figures given in T. H. Middleton's Report (Cd. 8305), p. 40.

diagonally from the North Sea to South Central Russia. It has also appeared in the United States, mainly in Colorado, California and Michigan. The area under sugar beet has averaged about 5 million acres in Europe in recent years, with a much smaller area of about $\frac{1}{2}$ million acres in North America. The total acreage is thus small compared with that devoted to wheat or even to potatoes, but the crop is exacting and requires first-class land and an abundance of suitable fertilisers. Sugar beet also require careful cultivation and considerable human labour for harvesting, and must therefore be regarded as competing directly with other forms of agriculture for both land and labour. Moreover, since beet sugar is produced in countries that are well adapted to animal industries, and in most cases have developed these industries extensively, its production appears to offer competition to the production of meat and dairy produce. As a general rule, experience in Europe shows that the spread of sugar beet cultivation has driven animal raising to some extent, and cereal cultivation to a greater extent, to other, and generally poorer, land. The growing demand for cereals and the protective policy of European countries have caused cereal production to be maintained, but animal industries of the pastoral type have suffered, because the net result of the whole change has been that pastures have been diminished in area. On the other hand, animal industries have often been able to maintain themselves in areas especially devoted to sugar beet cultivation, but in a new form. Instead of pasture grasses their principal rations consist of beet pulp combined with straw and concentrated feedstuffs of local production or imported. In Denmark, Holland, Southern Sweden and parts of Germany animal industries have constantly advanced with the increase in sugar beet cultivation.¹ However, in the case of the first three of these, at any rate, the production of cereals and of concentrated feedstuffs has been largely driven overseas, since they have come to import an increasing part of their requirements of these products.

The pulp returned from sugar factories is a valuable feed material since it is available throughout the winter as succulent matter necessary to supplement the rations of concentrated feedstuffs and hay for stock, thus taking the place of such root crops as mangolds and turnips commonly used in Great Britain. The beet sugar production of Europe in 1912-13 was over 8 million tons, and the amount of pulp available must have been over 40 million tons, though by no means the whole of this was utilised as stock feed. From this point of view the cultivation of sugar beet forms a basis for intensive animal industries leading especially to the production of beef, veal and dairy produce; and so far as the result is to increase the output of butter, it indirectly favours

¹ Sugar beet have been found valuable as a rotation crop in an intensive arable system of cultivation. Cf. (Cd. 8305), pp. 37-41.

pig-raising, which utilises the surplus skim-milk in the most profitable way.

The effects of the cultivation of this crop upon the production of animal foodstuffs are therefore complex. In any case, the direct contribution in the form of nutritious feedstuffs is small. Further, animal-rearing on the pastoral basis is directly diminished, and the supply of labour available for animal industries is also reduced. So far as the land is cultivated more intensively and is made to produce meat and milk as well as sugar, the net loss to animal industries may not be great, and these industries may even gain ground if concentrated feedstuffs are obtained from elsewhere; but then some allowance must be made for the cereals consumed by power animals in the work of cultivation. However, in the absence of sugar beet the land would probably be cultivated more or less intensively because of its high quality, and would yield a greater quantity of fodder and feedstuffs than at present. A man-gold crop, for example, cultivated with the care usually given to sugar beet, would produce a much greater quantity of nutrient stock feed than the pulp residue of a beet crop on the same land does, and would fit equally well into any system of rotation. Thus while the great development of sugar beet cultivation in Europe has in some ways been favourable to animal industries, so far as it has restricted the resources in productive land, it has been unfavourable. On the whole, sheep-farming has perhaps suffered most through this development, and cattle-rearing least, as compared with the extent to which animal industries might have developed, if the countries of Europe had continued to rely upon the tropical lands for their supplies of sugar.

From the point of view of human food supplies in relation to land area, it must be borne in mind that the 8 million tons of sugar annually produced from beet prior to 1914 formed a considerable element of nourishment in the dietary of white populations, and thus relieved land to some extent from the production of other equivalent foodstuffs. Animal industries, however, are almost entirely confined to the temperate regions, and from the point of view of such industries, the case for sugar beet would retain its force only if sugar could be produced nowhere except in the richer agricultural lands of the North Temperate Zone. Now at least one half of the world's sugar output is produced in the tropics from sugar cane; and under the present circumstances, from the general standpoint, any relief from the tropics in the production of foodstuffs and feedstuffs is to be welcomed.¹ There seems no reason why sugar cane should not be grown much more extensively than at present² in view of the pressure upon agricultural land in the temperate

¹ Compare Chap. v., above, in which assistance from the tropics under other heads is discussed.

² There has, of course, been a great increase in the production of cane sugar during the European War, and this increase may in a large measure become permanent.

regions. Some authorities maintain, therefore, that beet sugar cannot in the future compete successfully with cane sugar.¹

(e) FIBRE CROPS.

Some reference has already been made to the demands of the cotton crop upon agricultural lands in the United States. Outside the United States, the area throughout the world devoted to cotton, that could profitably be utilised for the rearing of animals or for producing surplus animal feedstuffs, is not great. The average acreage under cotton in recent years in the United States has been about 35 million acres, and the crop is such that it requires rich land and is exhaustive of soil fertility. However, it is the seed rather than the fibre that drains the richness of the soil. A large part of the American cotton-seed output is crushed, thereby furnishing oil for human consumption and oil-cake and meal for live-stock. Though the nutrient value of cotton-seed is high, it can hardly be maintained that the land annually under cotton is producing in this way as great a quantity of animal feedstuffs as would be obtainable from other crops such as maize, sorghum, etc.,² if these were given as favourable treatment in fertilisers and cultivation. Cotton-seed oil is an important article of commerce that enters, it is true, largely into human diet in various forms, but there exist other sources of edible oils, as has been shown, and these sources which are constantly growing in importance are not generally suitable for animal industries. Any extension, therefore, in the area devoted to cotton in North America or in other temperate countries must, on the whole, be regarded as being unfavourable to those branches of agriculture concerned with the production of food, and especially perhaps to animal industries, since in the United States the cotton belt has tended to move westwards and to invade what were formerly cattle ranching lands.³ On the other hand, within the cotton belt, the threatened exhaustion of the soil through continuous cropping with cotton has begun to make rotation farming with fodder crops and animal industries necessary.⁴ The United States Department of Agriculture has instituted something like a campaign in favour of the extension of beef production and dairying in the Southern States in combination with cotton cultivation.⁴ The future extensions of cotton growing throughout the world are much more likely to take place in tropical and sub-tropical regions in Africa, Southern Asia, Brazil, and Northern Australia; in districts, that is to say, not utilised to any great extent at present for animal-rearing. So far as ex-

¹ See E. Hahn, *Die Wirtschaft der Welt am Ausgange des 19 ten Jahrhunderts*, p. 79.

² More especially as an appreciable part of the cotton-seed is returned to the land as fertiliser.

³ See A. P. Brigham, *Commercial Geography*, 1911, p. 24.

⁴ See U.S. Dept. Agric. Year Book, 1913, pp. 259-283.

Ibid., Animal Industry Report, 1907, pp. 307 *et seq.*, and *Farmers' Bulletins*, Nos. 349, 411, 580, and 655.

tensions are made in North America, they will probably be so in conjunction with mixed farming in which animal industries will be prominent. It is now recognised everywhere in the more valuable agricultural lands of the temperate regions that the time of successive ready-money crops, leading inevitably to soil exhaustion, has passed. This applies to cotton as well as to cereals.

Another important fibre crop of temperate climates is flax, but a much larger area is devoted to the production of linseed than to the production of fibre, the respective annual averages being about 14 million acres, and about 5 million acres. Of the latter about $3\frac{1}{2}$ million acres have been in Russia alone. The cultivation of flax for the fibre yields no by-product of value for animal industries, so that the area thus occupied is lost to food production. However, this area shows no marked tendency to increase. Flax grown for linseed (cultivated mainly in North and South America and India) yields a valuable commercial oil, that at present enters in no way into human foodstuffs or animal feedstuffs. On the other hand, linseed cake and meal, resulting as a by-product of crushing the seed for oil, is one of the richest concentrated feedstuffs for live-stock and is suitable for different kinds of animals in a way that some others, for example, cotton-seed cake, are not.¹ The total production of linseed in recent years has been about 120 million bushels (average of the years 1911–13), yielding about $1\frac{1}{2}$ million tons of feedstuffs. Linseed is a crop more favourable to animal industries than cotton is, owing to the greater value of the feed-cake residue, a higher percentage of cake from a given weight of seed, and to the fact that the whole available crop is milled, while much cotton-seed is returned as fertilisers to the ground.² Moreover, cotton-seed oil acts as a foodstuff in competition with animal fats, while linseed oil does not. Since it does not seem possible to find efficient substitutes for linseed oil in the arts and in manufacture, the demand for the oil will probably determine the extent to which the linseed crop is grown, and that may easily increase in the future.

From the point of view of animal industries, land devoted to linseed might perhaps produce a greater quantity of feedstuffs, if sown to the typical feedstuff cereals or to some fodder crop instead, but the difference is not very great. On the balance, therefore, the cultivation of linseed on the present limited scale offers no serious competition to animal industries, and the area devoted to flax for fibre is comparatively small and is not likely to increase rapidly in the future.

¹ Cotton-seed cake or meal is usually fatal to pigs.—U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin* 47.

² In the New World linseed has been found especially suited to virgin soils on which it yields a safer and a more rapid return to the pioneer farmer than the common cereals.

(f) FORESTS AND TIMBER SUPPLIES.

The rapid consumption of the stocks of standing timber in all temperate regions by saw-mills and paper mills, for firewood, and by forest fires is a serious factor, the influence of which upon agricultural industries is beginning to be felt. In the United States, where the rapid destruction of natural forests has been most marked, and where the rate of consumption is increasing most noticeably, it is stated that a timber famine is threatened. It is not likely that the rate of consumption of merchant timber throughout the world will decline in any great measure in the near future, though the consumption of firewood may be reduced by an increased output of coal, and forest fires may become less destructive with the adoption of more effective precautions against their occurrence.

The destruction of forests in many parts of the world has been hastened by the desire to clear the land for pastoral industries and for cultivation,¹ and much timber has been destroyed on the ground where it grew, because too far from means of communication to be of immediate market value. The net effect of the methods of forest exploitation, as practised during the last fifty years, has been to increase the supplies of wool and meat available for export from new countries at the expense of future timber supplies. Unfortunately, large areas of hilly land that have been denuded of their forests in North America and elsewhere have soon lost their original fertility through surface erosion, and are now producing neither timber nor pastures.²

It is indeed doubtful whether wholesale timber-cutting can safely be proceeded with anywhere in the temperate regions, except, perhaps, in Canada and Northern Russia and Siberia, when proper consideration is given to the world's future requirements in timber supplies, and to the avoidance of permanent injury to climatic conditions and soil fertility. Even in Canada, Russia and Siberia the forests are said to have a moderating effect upon climatic extremes,³ so that their disappearance would reduce the productive capacity of the agricultural lands lying to the south of them.

There are, of course, enormous tracts of untouched tropical forests still remaining in the world, and these are capable of supplying commercial timbers; but besides difficulties connected with labour and transport, the number of useful varieties is limited and does not include many that are easily worked. These forests will probably not be called upon to furnish an important part of the

¹ In their evidence given before the Dominions Commission in 1913 a number of New Zealand witnesses seemed to think that it is desirable to convert as much as possible of the still intact forests into sheep runs in the shortest possible time, but they did not dwell upon the need for afforestation.

² Compare American Report on Soil Erosion and Forest Conservation Yearbook of Agriculture, 1913, pp. 207-221, also U.S. Dept. Agric., *Bulletin* 180.

³ See Bonmariage, *La Russie d'Europe*, Chap. vi.

world's supplies till the price has risen well above the present level.¹

There seems to be no escape from the conclusion that temperate countries will be obliged to practise afforestation on an extensive scale in order to compensate for timber-cutting. That is to say, it will be more profitable for these countries to use part of their land area for forest planting rather than become dependent upon remote or tropical sources of supply. In any case, there are a number of species of trees, yielding timbers in common use, that grow only in extra-tropical climates. Something has already been done, especially in Europe, in planting forests of quick-growing trees (notably in Germany, Belgium and France) and there are indications that this movement will spread under government control in all the more densely peopled countries of the temperate regions where the consumption of timber is greatly in excess of local supplies.²

The question arises as to how far re-afforestation will make demands on land now used for agricultural and pastoral industries. In those countries that still have extensive forest areas, such as Russia and Sweden, Canada, Siberia, and to some extent also the United States, future developments in timber-cutting and re-afforestation will probably not cause much more land to be reserved under forests than at present, but there will be a redistribution of the areas so occupied. As timber is cut from standing forests, the more fertile and better situated areas will be taken for agriculture, while the more elevated, hilly, colder and less fertile areas will be replanted at once. At the same time much of the more elevated and practically useless land will be afforested. It is also possible that the increase in the demand for timber in the densely populated timber-importing countries, such as Great Britain, the countries of Western Europe and parts of Eastern North America will cause afforestation to encroach upon existing productive agricultural lands in these regions, and perhaps even elsewhere.

From the point of view of animal industries, afforestation in temperate countries would first affect those poorer regions that are now used for rough grazing, and sheep would therefore be chiefly affected in the first stages. If the process of afforestation proceeds to any great extent, animal industries will be driven more and more to an intensive basis of working. On the other hand, rising prices for timber may check consumption and cause substitutes to be used more widely, so that afforestation may not claim any considerable areas of productive agricultural land. Nevertheless, this process certainly does threaten to withdraw certain rough pastoral areas as forest reserves.

¹ Tropical forests are usually very mixed, and the timbers of comparatively small commercial value. The difficulties in felling and cutting are enormous owing to the profusion of jungle creepers and undergrowth. Transport is almost impossible on the marshy ground except along the rivers, and the labour question causes further difficulties. Some of the timber are heavier than water and cannot, therefore, at present be made available to commerce.

² Compare Report of a Royal Commission in Great Britain (Cd. 4460).

During the last fifty years the world has been living upon accumulated reserves, not only of forest timbers, but also to some extent of the soil fertility of land cleared of forest, wherever the original fertility has not been maintained. Generally speaking, the limits have been reached within the temperate zone, with one or two exceptions, in the process of converting large forest areas into productive pastoral and agricultural land. It follows, therefore, that the entire question requires to be viewed from the new standpoint of conservation not only of timber supplies, but also of the fertility of agricultural land so far as it is controlled by the existence of forests and woodlands.

CHAPTER XII

COST PRICE AND COSTS OF PRODUCTION

THE costs of production of any commodity, by influencing the amount of the supplies available at a given price, have an indirect bearing upon movements in the market price.¹ In the preceding chapters the questions relating to the resources available now and in the future for the production of animal foodstuffs throughout the world have been considered. The general conclusion has been that the exportable surplus of such foodstuffs from the principal producing areas is not likely to increase as rapidly in the near future as it has done in the past, owing to the limited extent of accessible productive land, and to the competition exercised by food cereals, fibre crops and forest reserves for the use of such land. With a view to elucidating questions of the cost price of animal foodstuffs, it is now proposed to survey the conditions of supply, both present and future, with especial reference to the costs of production.

Two features in particular seem likely to predominate in the conditions of supply in the near future. In the first place, tropical highlands will probably furnish meat and meat-products, and tropical lowlands oil-bearing nuts and seeds, on a much greater scale than hitherto; and in the second place, intensive methods of production are likely to gain ground in all the more advanced countries, whether of the industrial or of the purely agricultural type. The first of these will tend to lower the prices of animal foodstuffs upon the world's markets; the second will tend to increase them for a time owing to the general increased costs of production. Though intensive methods may lead to a greater output per acre, they do not necessarily mean a cheaper cost of production per unit, initially, at any rate, as experience has shown.²

In order to maintain the rate of expansion in the supplies of animal foodstuffs current during the last thirty years, it would be

¹ Demand is, of course, an equal factor in the determination of price. The discussion of questions relating to demand is reserved for Part II., below, dealing with consumption.

² The industry of beef-production, which is conducted under the extensive (or ranching), and also under intensive methods, is a case in point that shows clearly how the latter methods involve increased costs of production. The charges for land, practically non-existent under the ranching system, become heavy as a rule under the intensive system. The same is true of the charges for buildings and equipment. Very little labour is required under the former system, and a great deal under the latter for successful management. Concentrated feedstuffs also have to be grown or purchased when a smaller area is used on the intensive system. Compare U.S. Dept. Agric. Office of Sec. Report, 109, p. 165, "The increasing cost of production may also be regarded as a factor" (in the rise in meat prices).

necessary now (failing rapid progress in intensification) to have further large areas of undeveloped fertile land to fall back upon. However, with the exception of certain parts of Siberia and the tropical highlands, all of which regions have marked disadvantages, such areas no longer exist. Hence the fact that consumption has begun to overtake supply, a fact that became apparent shortly after the year 1900, and has become especially marked since the year 1908.¹ Though various theories have been advanced in different countries to explain the rise in prices since the year 1900,² there cannot be much doubt that the obvious explanation is the correct one; shortage of supplies relative to consumption has been the most potent factor.³ Roughly speaking, between the years 1880 and 1900 farmers throughout the world were producing more animal (and other) foodstuffs than they could dispose of at remunerative prices,⁴ while since the year 1900, dealers, if not the farmers, have been more and more able to dictate prices to the consumer. Farmers, as a class, have not, however, reaped the full benefit of the increased prices.⁵ Costs of production have risen for all except those who have remained for some time owners of the land they use, and who do not need to purchase feedstuffs extensively. Even those who work under the ranching system appear likely to be affected in the future, if not so already, by increasing costs of production.⁶

The increased cost of production and most of the other supposed independent factors in the rising prices of animal foodstuffs, are ultimately traceable to a reduced rate of development of new land

¹ The recent shortage in meat supplies has been all the more marked, because the productive capacity of natural pastures in certain countries, such as the United States, Canada, Australia, and New Zealand has suffered; so that more land is required per head of stock. Thus, even if land values had not risen, the cost of production would be greater (see notes 5 and 6 below).

² See Internat. Agric. Inst., *Bulletin of Social and Economic Intelligence*, April, 1912.

³ "The upward trend of prices of all classes of meat animals and of meat . . . is observable in all countries for which information has been obtained. . . . The general fact is that production has not kept up with the increase of population in some degree, and with the customary demand by meat consumers. The inevitable measure of this changed relationship between supply and demand is price. . . ."—U.S. Dept. Agric. Rept., 109, p. 152.

⁴ Cf. U.S. Yearbook of Agriculture, 1910, p. 19.—"It has been shown that for many years previous to 1897 or later the prices received by farmers were even less than the costs of production."

⁵ See U.S. Dept. Agric., *Farmers' Bulletin*, No. 575 (published 1914), p. 4.—"This unprecedented increase in the average value of meat animals does not necessarily mean that farmers or stock-raisers are making more, if any profit. On the contrary, the cost of production has probably increased more rapidly than the increase in the selling price of live-stock. Complaints of a similar nature were also common in Europe prior to the year 1914."

⁶ See U.S. Dept. Agric., Office of Sec. Rept., 110; entitled *Live-Stock Production in the Far Western Range States*, p. 5.—"The future costs of producing meats on the Western Range areas will certainly not be less, and in most sections will probably increase."

areas. One or two social factors, which are really independent of this prime factor, will be discussed below.

It has been noted in the introduction above that there is no hard and fast distinction between animal foodstuffs and other kinds of agricultural produce, so far as production is concerned. Animal industries are only one branch of general agriculture, and attention may be given to them or withdrawn from them, within certain limits, more or less at will.¹ It follows, therefore, that at any given time the same general relations hold for animal foodstuffs between supply and demand, as for other kinds of agricultural produce. It is true that in some instances land is suitable only for maintaining food-producing animals, or has such special advantages for that purpose, that other forms of agriculture are more or less unprofitable; but the great bulk of the world's supplies of animal foodstuffs is not produced on such land. In any case, cheap transport for food cereals and for feedstuffs tends to level out such differences in the utility of land. Owing to changes in the methods of production, however, the prices of various kinds of foodstuffs show different rates of advance in the period from 1896 onwards. In this matter the application of machinery and the adoption of simpler methods of production have played an important part in special instances. The table below shows that meat has risen faster in retail price in London than wheat, and both have risen faster than dairy produce, in the production of which machinery of different kinds has greatly reduced the human labour involved.² The production of meat, on the other hand, has rather become a more complicated process owing to the comparative decline of ranching and the corresponding increase of special feeding.³

Retail prices in London, taking those for 1896 as 100 :—⁴

	BREAD, FLOUR, POTATOES.	MEAT.	DAIRY PRODUCE.	WEIGHTED INDEX OF 23 FOOD ARTICLES.
1896	100	100	100	100
1905	114	112	105	112.1
1913	129.2	134	116.5	125.2

¹ Compare Marshall, *Principles*, V., viii., para. 4.

² See Chap. ix. above, pp. 151-3. The actual rise in the prices of dairy produce from other sources in London in the period 1900-1913 may be masked to some extent by the growing imports of cheap Siberian butter.

³ The London prices for meat in the period 1900-1905 were perhaps abnormally depressed by American supplies which were sold at what were to some extent "dumping" prices.—See (Cd. 2644) QQ. 4084-4117 and 4125-7.

⁴ Adapted from the Board of Trade Index Numbers by converting from the year 1900 as base to the year 1896.

The consuming population has increased faster than the number of meat-producing animals,¹ and this is especially true of the great consuming continents, namely, Europe and North America. The survey of the various surplus-producing areas has shown that the limits of surplus production under the present methods are in sight,² the only notable exception being temperate South America. Since the year 1900 the shipment of live animals from the New World to Europe has declined almost to vanishing point, while the world's total of exported meat supplies has risen but moderately. The United Kingdom has received the bulk of the live animals sent from overseas ports to Europe.³ The decline in this trade since is a remarkable one. In 1901 cattle numbering 495,635 and sheep numbering 383,594 reached the United Kingdom, while in 1913 the corresponding figures were 14,743 and 501.⁴ The total exports of meat and meat products from the nine principal surplus countries are shown in the following table for different years.⁵

YEAR.	MILLION LBS.
1899	3,520
1903	3,100
1906	3,778
1912	3,861
Average for years 1898 to 1911	3,500

For these exports the countries of Western Europe were, of course, the chief customers. When allowance is made for the decline in the numbers of live food animals imported into them, it will be seen that the actual increase in the quantities of meat, alive and dead, that reached them from other continents were very little, if at all, greater in 1912 than in 1899.⁶ The increase is in any case small compared with that of the potential demand for meat in Western Europe, since every increase in population in an area already fully occupied as agricultural land, tends to cause a greater proportionate increase in the demand for imported meat, owing to the immobilisation of an increasing proportion of that limited area for the production of cereals and other food crops. The difficulty has, however, been obviated to some extent, first by making the land more productive under intensive methods, and

¹ See Chap. iii. above, pp. 37-9.

² Compare the following quotation from an American writer:—"Among most peoples of the world meat is something of a luxury and is becoming more so.—J. Russell Smith, *Industrial and Commercial Geography*, p. 119.

³ The only other European countries that have imported notable quantities of live animals from places outside Europe, are France (from Algeria and Madagascar), and Russia (from Siberia).

⁴ Pigs are omitted because seldom transported as live meat by sea.

⁵ The figures in this table have been taken from Report 109, U.S. Dept. Agric. Bureau of Crop Estimates, pp. 72-3. They include the exports from European countries such as Denmark and Holland which have themselves increased and should, in strict accuracy, be omitted for the purpose of the comparison.

⁶ Cf. Chap. viii. above, p. 141 and note 1.

second by increasing the imports of cereals and of concentrated feedstuffs.

If the factors in the cost of production of animal foodstuffs are analysed under the main heads of land, labour and capital, it will be found that the charges for each have increased during the last twenty years.

The limitations set by nature upon the areas of land available under the present conditions has caused keen competition to arise for the use of that land among the various forms of production. Not only is the area limited, but the progress of settlement in the newer countries appears to favour the spread of weeds, pests, and plant diseases besides causing a reduction in the natural fertility. The original flora and fauna are quickly killed out by the hand of man, but later "soil fertility shows signs of depletion; weeds, fungus diseases and insect pests, unknown a generation ago, are to be combated."¹

The world's food requirements are such, it must be repeated, that animal industries are bound to take second place, to become residual, when limitations of productive area begin to be felt.² The most important and pressing need is for food crops, and the production of these has been advancing at least as rapidly as the consuming population has increased. The value of agricultural land has risen rapidly in most countries owing to its comparative scarcity in relation to the sum of all the demands made upon it. The rise has been most startling in the new countries where large areas of cheap land were still available twenty years ago for raising meat-producing animals. Thus in the United States the value of all farm lands is stated to have risen by 118% in the ten-year period 1900 to 1910.³ Similar increases have taken place in Canada, Argentina, Siberia, New Zealand and in European countries such as Germany and Holland. Although considerable areas of land, that will ultimately be utilised for agricultural production, still remain untouched in the newer countries, much of it is forested or distant from the means of transport. The expense of clearing such land is a capital charge upon it,⁴ and the difficulty of obtaining labour for this purpose tends to keep it out of cultivation.

Land values and rent are an effect rather than a cause in the process of agricultural production, and their levels arise from the prices realised for the produce as a whole. When, however, one group of agricultural industries is separated from all the groups that compete together for the use of the available land, the price which has to be paid for land or the (commercial) rent demanded for its use, amounts in practice to a factor in the cost price of the

¹ U.S. Dept. Agric. Bureau of Statistics, *Bulletin* 73, p. 9.

² For a fuller discussion of this question, see Part II, Chap. v.

³ Report of the 13th U.S. Census, Vol. V., p. 42.

⁴ The expense of clearing forested land in Canada, for example, has been estimated as ranging from 20 dollars to 125 dollars per acre.—Dominions Commission, (Cd. 8457), p. 16.

commodities produced by that group.¹ Animals are not reared to the same extent as previously on certain areas, because, as it is said, the land "has become too valuable"—that is, under the current methods of stock farming; nor can they be raised as cheaply as before on the remaining areas, because with the rise in rent or in the interest charges upon capital invested in freehold land, the old price is no longer a profitable one. Higher land values are a symptom of a comparative shortage of effective agricultural resources, and when this appears, the well-being both of the producer and of the consumer requires the introduction of more intensive farming methods. These, however, tend to spread slowly in the conservative agricultural world, and whatever effect their general adoption may ultimately have in reducing the costs of production of foodstuffs, they tend in the initial stages to increase rather than to diminish those costs for the individual producer by adding to his outlays for capital and labour.

It is to be noted that, although increase in population relative to the area of productive land is the most potent cause for the increase in land values, the intensity of the demand per capita for animal foodstuffs is a contributing cause. A rise in the proportion of animal foodstuffs in the diet of a stationary population living upon a limited area of land would, in the absence of more intensive methods of production, cause an increase in the values of land in that limited area, owing to the operation of monopoly conditions. Now pressure of population and the increased standard of living tend to introduce monopoly conditions as a controlling factor in the prices of land, in all parts of the world under the commercial influence of the white races.

The development of world-trade has been such that the prices of agricultural land tend quickly to the same level, when allowance is made for differences in fertility, accessibility and ordinary social amenities. Only in a few areas, and notably in Great Britain, does a distinct non-productive factor, namely, the special social status and the increased political power conferred by land ownership operate strongly as a factor in raising the market value of land above the competition level in the strict economic sense. It may be noted, however, incidentally, that extensive speculation in land may raise its capital value to a point above its actual productive

¹ See Schmoller. *Grundriss der Allgemeinen Volkswirtschaft*, p. 609 :—"The restricted area of good and accessible land has caused demand to make higher offers, has raised prices so that rent has emerged, and it forms now with its result of enhanced capital value of the land an essential element in the whole process of production of all single enterprises among themselves, and in the setting forth of all estimates of the costs of production."

Compare also the following quotation :—"The rental value of land is not ordinarily considered by farmers as an item of expense, especially in new farming regions, where prospective rises in land values are included in the expectancy of profits. This item cannot be ignored, however, in determining costs of production or net profits."—U.S. Dept. Agric. Bureau of Statistics, *Bulletin* 48, p. 36.

value. This has happened especially in new countries, and the agricultural industry in the districts so affected has been thereby loaded with excessive charges in the costs of production that have resulted in some cases in checking temporarily its expansion.¹

With regard to the influence of land values upon the prices of animal foodstuffs, the chain of causation seems to be as follows: the pressure of the increasing demand for agricultural produce has caused a distinct upward trend in land values, so that large quantities of beef and mutton can no longer be produced upon free or very cheap productive land in the new countries; the prices of these meats upon the international market are, therefore, no longer controlled by the competition of vast supplies produced cheaply under these conditions, and show in consequence a distinct upward movement; incidentally the meat-consuming populations have to rely more upon pig-meat produced upon high-priced land and less upon beef and mutton for their meat supplies. Finally, since dairying is in some measure an alternative to the production of meat in live-stock farming, and as an industry has also felt the upward movement in land values, the prices of dairy products have also risen, but not to the same extent for reasons that have already been indicated.

With regard to the labour costs, it is to be noted that the limitation of land area and the consequent rise in land values has made it necessary to attempt more intensive methods of animal husbandry, which in their turn make greater demands for human labour in proportion to the output. Except in dairying the introduction of machinery has not been rapid enough in mixed farming to make it possible to produce a given quantity of animal foodstuffs with the same amount of labour on a small area by intensive methods as on a larger one by extensive methods. Now in recent years the change towards intensive methods has been more noticeable in animal industries than in other branches of agriculture. The general advances made in the breeds and quality of meat-producing animals have made more attention necessary to the tending and feeding of them. All such developments involve a greater expenditure of human labour and thought, more technical knowledge, and a greater degree of organisation.

Not only, therefore, is a larger amount of labour necessary under intensive animal husbandry than under the open grazing system, but also the nature of the work is such that a higher wage for labourers and a higher remuneration for farmers must be forth-

¹ Western Canada is a case in point. In British Columbia "the land values are generally considered to be as high now as they should be at a much later stage of development of the Province."—U.S. Daily Commerce Reports, April 9th, 1913, p. 161.

Compare also the following quotation:—"This apparent anomaly between rents and productiveness in some instances is caused by the pressure of population upon land, by *land speculation*, and a lack of realisation by the tiller of the soil of the relation of rent to net profits."—U.S. Dept. Agric. Bureau of Statistics, *Bulletin* 48, p. 10.

coming. Since also intensive agriculture (including animal rearing as the main feature) has begun to be practised most in regions of dense population where manufacturing industries with their comparatively high rates of wages tend to compete with agriculture for the supplies of labour, the general result is an advance in the price of labour in the rural districts of intensive agriculture. The time seems to be coming in the majority of temperate animal-rearing countries when cheap labour, like cheap land, will be a thing of the past. In certain regions where there does not appear to have been any marked rise in agricultural wages, as in parts of England and of the Continent of Europe, it is probable that the average quality of the labour available has suffered through the withdrawal of the more intelligent and able-bodied young men to town factories or by emigration to the newer countries overseas, so that the real price has probably risen considerably. The general movement throughout the world in the direction of shortening the hours of work may also react unfavourably upon animal industries in which the business of tending animals often demands long and tedious hours of work. In other branches of agriculture there has been a more evident compensation for shorter hours of work through an increase in efficiency with the utilisation of machinery.

Closely connected with the above is the marked withdrawal in all industrial countries, of cheap female and even child labour from the land. The young women find employment in the towns in factories or (with the rapid increase in the proportion of the middle-class population) in domestic service; the children are kept longer at school, and, so far as they live in towns whither their parents have migrated, their free time is not available for miscellaneous farm work. Now the tending and feeding of animals and poultry were often left to women and children under the system common enough in many parts of Europe a generation or more ago. The employment of such labour had for its chief, and perhaps its only merit, that it cost little or nothing.

Finally, in connection with the question of labour costs, since an increasing proportion of the world's supplies of animal foodstuffs has, during the last thirty years, been produced in the newer countries, where labour is universally expensive, it follows that any changes in the labour costs in them tend to be reflected more strongly in the prices of animal foodstuffs in the world-market. Now the relative decline of the ranching system, which required little labour in proportion to the output, has since about the year 1900 considerably increased the labour required per unit produced, with a consequent distinct rise in market prices.

On the whole, it appears that the item of labour in the cost of production of animal foodstuffs has risen considerably, except where machinery has been of material assistance, and will quite probably rise still further.

Under the third factor, namely, the charges for capital, it is

convenient to include also those charges that arise for the capital invested in the machinery of distribution.

Changes in the proportions of town and rural population, together with the great increase in plant, buildings, and transport and storage facilities, have led to capitalisation and industrialisation on an ever-increasing scale in the preparation of, and the trade in, animal foodstuffs. In this connection the enormous aggregate sums of capital held by wholesale and retail agents in distributing these foodstuffs, may also be noted.

The value of farm live-stock alone in the leading countries represents a capital sum, which is probably more than double the figure of twenty-five years ago. However, the more valuable stock require more costly equipment, so that a further increase in capital charges appears. It has been observed above that there has been a considerable increase in the capital outlays on the part of the various organisations for the collection, manufacture, storage and distribution of the perishable animal food products. The fact that a number of operations, such as meat-packing, bacon-curing, and even the manufacture of butter and cheese, formerly carried out on the farms, have been largely transferred to factories, and the treatment of the non-edible products entirely so, means that the hold of urban capital over animal industries has been greatly increased; and the marked increase in the size and financial power of the wholesale agencies in the large towns has strengthened this movement. It is not to be supposed that a return to the old system, if it were possible, would prove more economical; the contrary is more likely, since the big trading company has made its way in competition owing to economies of management. Nevertheless, what requires to be kept in view at this point is that the concentration of populations in towns has necessitated a much more highly organised system of distribution within the same country, and has, incidentally, led to the building up of large undertakings with heavy aggregate holdings of capital, engaged in one way or another in the business of transferring animal foodstuffs from the farm to the consumer; while formerly, when the proportion of urban population was much smaller, the same work was done for a majority of the population by self-supply, by barter, or through the services of the small local dealer, and naturally, therefore, cost less.¹ The centralising system has now gone so far that in many parts of England and the United States the needs of the rural districts in certain kinds of animal foodstuffs, are supplied from factory centres. There is, moreover, reason for believing that while the large modern organisations were building up their business against competition, they did their work cheaply, but that some of them, having established a practical monopoly, exact

¹ The most remarkable instance of increased charges following upon the migration of consumers to towns, for services in transporting and distributing animal foodstuffs and keeping them fresh in the interval, occurs in the case of milk.

heavily from both the producer and the consumer. The organisation known as the American Meat Trust is apparently a striking case in point.¹ This item of capital charges has tended to increase also with the steady rise in the rate of interest from about 3% in 1895 to 5% or more in 1913, which has not only affected live-stock farmers, but has also tended to raise to a corresponding extent the profits of the concerns engaged in handling the products.

There seems to be no likelihood that in the future, with the inevitable general increase in intensive methods of production and with the continued increase in urban populations often living at a distance from the centres of supply, there will be any halt in the investment of capital in the production and distribution of animal foodstuffs. Unfortunately, also, in this connection the general rate of interest for capital will probably be higher than the 1913 level in the near future, owing to the European War and to other causes already in operation before it.

The cost of animal foodstuffs to the consumer has been incidentally increased during the last thirty years above what might otherwise have been the current level, owing to several special factors, some of which are rather of a social than of an economic nature.

Partly owing to the advent of large-scale undertakings, the character of the goods as consumed has shown some change. Animal foodstuffs are now of a higher and more uniform quality as they reach the consumer, than formerly. Whereas prime beef, mutton, bacon, and poultry were not the rule thirty years ago, the reverse now tends to be the case in the great markets of Western Europe and North America. Specialisation and increased attention to details in the breeding and care of animals have resulted in the production, on an extensive scale, of early-matured and well-finished meat from all classes of food animals, including poultry; so that what were formerly rather luxuries for the rich only have now become to some extent standard products. Similarly also uncertainties in the quality and freshness of such perishables as butter, milk and eggs have largely disappeared. It is true that from the producer's point of view early maturing animals are more economical feeders, but the quality of the feedstuffs must be of the best, and they cannot so well be left to shift for themselves as ordinary live stock. Moreover, considerable additional capital requires to be invested in breeding-stock, shelter and equipment.

The regularisation of the supplies of animal foodstuffs from season to season may have resulted in a general levelling up of prices for the consumer. These products are no longer subject to a market glut during the summer, followed by absolute scarcity during the

¹ "The manufacture and distribution of meat products is an immense business in itself and the indications are that the profits are correspondingly large to everyone concerned between the original producer and the ultimate consumer."—U.S. Dept. Agric., *Farmers' Bulletin*, No. 575 (1914), p. 5.

It is only fair to add that so far as animal foodstuffs are concerned cases of quasi-monopolist exactions have hitherto been rather exceptional than the rule.

late winter. Seasonal fluctuations in supplies have been levelled down in several ways : first, by the utilisation during the northern winter of products from the Southern Hemisphere ; second, by winter feeding on a large scale in the Northern Hemisphere both of dairy cattle and of meat-producing animals ; and third, by cold storage, whereby the surplus supplies produced during the flush of the season are held over to a time of scarcity. The first of these has had the effect of lowering prices, but the second and third have tended to raise them on the whole, since stall-feeding is more costly than grass feeding, and produce preserved in cold storage more expensive, other things being equal, than that preserved by salting, and it is certainly more expensive to rely upon cold-storage meat and butter than to do without them during the winter months. The fact may be overlooked that, whereas the consumer formerly paid a very low price during the summer, and managed with little except salted stores during the winter, he now pays a uniform moderately high price throughout the year.¹ In point of fact, the consumption of fresh animal foodstuffs (*i.e.*, those not preserved by salting) is now naturally greatest during the winter months precisely at the time when production, except as regards supplies from the Southern Hemisphere, is most costly. The possibility of holding supplies of perishable animal produce in cold storage awaiting a rise in demand, does perhaps enable speculative dealers to obtain an inflated price from the consumer in certain cases. So-called “corners” are not unknown in animal foodstuffs, but the operation does not appear to be very common owing to the rapidly increasing costs of storage with the lapse of time.²

In recent years, also, with the growing control by governments over public health requirements, there has been a considerable increase in the sanitary regulations concerning perishable foodstuffs, which have led to systematic inspection by officials, and alterations in the methods of production, preparation and distribution at their

¹ See U.S. Dept. Agric. Bureau of Statistics, *Bulletin* 101 (1913) entitled “Cold Storage and Prices” from which the following table of percentage increases in price due to the storage of butter and mutton (showing respectively the lowest and the highest percentages) is taken :—

Time of storage in months 	1	3	6	9	12	15
Cost of storage { butter as percentage of price { mutton	2·4	7·3	14·6	21·9	29·2	36·5
	3·8	11·5	23·0	34·5	46·1	57·6

The above figures are an average of a number of American towns in 1910-11.

² See last note above. The writer of the Report quoted leaves it an open question whether cold storage has been used by speculators and dealers as a means of raising prices unduly to the consumer.

directions. This development has resulted, of course, in a net gain of welfare to the community, but the indirect effect has been to increase the cost of such foodstuffs as they reach the consumer, in spite of the fact that the costs of administration are borne out of general taxation and are not, therefore, added to the price; the increased charges for improved sanitary methods plant, and equipment, on the other hand, do constitute an addition to the price. Among perishables, animal foodstuffs have been most liable to be affected by sanitary regulations.

In addition to the essential increases in the costs of distribution following upon the greater concentration of populations in towns, the last thirty years have seen a great increase in retail facilities for the consuming public.¹ Shops and services have not only multiplied beyond the increase in population, but have become more elaborate and costly. This feature has been at least as marked in the retail trade in animal foodstuffs as in that in other classes of goods. As a general rule, the charge for any such increase in facilities and services is added to the consumer's price. The organisation of wholesale and retail trade interests, with the rise of huge concerns controlling hundreds of branches, with combinations and associations among wholesalers and retailers resulting in price-regulation and the practical elimination of competition tends to strengthen trade profits in perishable foodstuffs, sometimes apparently, but not necessarily, and by no means always at the expense of the consumer. In general, it is the abuses of the modern system of distribution, rather than the system itself, that has given rise to complaints on the part of consumers in certain countries.

CO-OPERATIVE PRODUCTION AND MARKETING.²

Owing to the marked advance in the costs of producing and marketing perishable farm produce in recent years, and to the increased hold of dealers and capitalistic organisations over all operations connected with the transference of such goods from the original producer to the final consumer, co-operative ideas have spread widely among producers, and, to a smaller extent, among consumers. Co-operative methods, as hitherto developed, aim at securing increased profits for the producers by cheapening the costs of production, and by eliminating intermediaries in the process of marketing as far as possible. In so far, however, as they lead to an increase in the supplies and permanently lower the actual cost of the goods as delivered, they benefit the consumer also. Actual experience and the opinions of many authorities indicate that the production and the distribution of animal foodstuffs

¹ In America "the cost of meats has been increased materially by the increase of service and particularly of delivery service demanded by the consuming public."—U.S. Dept. Agric. Office of Sec. Rept. 113 (1916), p. 54.

² See also Chap. ix. above, where co-operation is discussed under the head of supplies of capital and credit facilities.

are especially adapted to co-operative methods. Moreover, the successful adoption of intensive methods, which must be prominent in the future, depends in no small measure upon intelligent co-operation in production and marketing.

Though little has so far been done in the direction of organised co-operative production of animal foodstuffs in England and the United States, this form of the movement is very much alive throughout continental Europe including even Russia, in Australasia, and in Ireland. In certain countries, particularly Denmark, Germany and New Zealand, co-operative production and co-operative wholesale marketing have developed remarkably, so that a majority of the live-stock farmers in each country are members of some co-operative organisation. The results as judged, whether by the standard of the produce or the general prosperity of the producers, are such as to justify the belief that much greater progress will be made throughout the world in this direction in the future. There is no doubt that the adoption of co-operative methods of production and marketing has the effect of increasing the output of animal foodstuffs relative to the population employed, and the progress of these methods is therefore of great moment in connection with the supplies of these foodstuffs, the production of which is apt to be restricted by the difficulty of obtaining sufficient labour. Under active government encouragement, the time may not be very distant when agricultural communities in many lands will produce and market a large part of their surplus animal foodstuffs and of certain other produce also, under co-operative methods.¹

Extensions of co-operation, such as are probable in the future, will tend towards reducing the costs of production and distribution and towards increasing the output per acre and per capita, thus counteracting to some extent the movements in the opposite direction discussed in the preceding paragraphs. Animal industries are all the more likely to be influenced by co-operative methods of production in the future, because of the rapid disappearance of the large-scale ranching system except in certain parts of the Southern Hemisphere and in the tropical highlands. It is precisely among holders of small and medium-sized farms (that is, those devoted to mixed farming with predominant animal industries), that co-operation is most fruitful of economies.

Agricultural co-operation in its completely developed form implies a kind of monopoly within a country. On the selling side however, co-operation has scarcely anywhere advanced beyond

¹ The production of cereals and other food crops seems generally better suited to large-scale methods, and, therefore, to areas of comparatively sparse population. The producers are usually somewhat scattered and their farms self-contained; their produce is easily graded, and their outlay for stock and equipment relatively small. It follows, therefore, that co-operative methods cannot be used as effectively in this industry as in animal industries of the more intensive type. Large-scale cereal production resembles manufacturing industries in some ways.

the first stage of dealing with the great wholesale markets; and there is no evidence to show that agricultural co-operative associations, even those representing federations of all producers within a country, will in the near future have sufficient organisation and financial strength to get control of the wholesale and distributing trade in the articles that their members are concerned in producing. As things are, and as they will be for some years to come, the commercial classes of the cities have the commanding financial strength in the marketing of animal foodstuffs. In any case, if the national co-operative associations of producers became powerful enough to obtain control of the entire system of marketing of their produce within each country, there would still, in the absence of prohibitive tariffs, be the competition of imports from other countries. The tendency is for perishable foodstuffs to be transported over longer distances and with increasing efficiency and cheapness, while the time of international combinations of agricultural co-operative associations seems quite remote. There is little danger, therefore, that agricultural co-operation will have the power to create price-raising monopolies. On the contrary, the indications at present are distinctly in favour of the conclusion that it will result in a tendency to reduce prices, consequent upon economies in production, transport and sale.

It has been shown above that the costs of producing and of distributing animal foodstuffs show a general tendency to rise owing to the increased cost of various factors. On the other hand, however, certain developments have arisen that make for a reduction in the final costs, and these, though discussed at various points in the preceding chapters, may be summarised here.

One of the outstanding causes of the increased costs is the growing limitation of accessible agricultural resources throughout the temperate regions as a whole. Against this, however, may be set, in the first place, the increased effectiveness as producing areas of considerable regions in the temperate zones, that will follow any improvements in the means of transport connecting these regions with the world's markets. In Chapter iv. above, it has been pointed out that such regions exist in particular in Argentina, Australia, Siberia and Canada. It must be allowed, however, that a shortage of capital may hinder the expansion of these works of development for some time to come. Secondly, the opening up of the tropical highlands as pastoral areas, a process that has been proceeding rapidly in South America and elsewhere, will serve to counteract partially the effects of the growing shortage of land in the temperate regions; but here also a shortage of capital may hinder development in the near future. Thirdly, the imports of oil-bearing seeds and nuts into the temperate regions from the tropical lowlands have increased rapidly in volume and promise to continue in the same direction. It is obvious that the trade in these materials, rich in both food-oils and feedstuffs, tends to

relieve the pressure upon agricultural resources in the importing regions. Fourthly, it is known that the yield of crops per acre can be greatly increased by means of artificial fertilisers. It has been shown above that the output of these fertilisers has grown rapidly and promises to grow at a still more rapid rate in the future, so that the agricultural output of the more accessible parts of the temperate regions may be greatly increased without any additions to the productive area. This, indeed, is one of the most promising ways in which the physical limitations in the available area of agricultural land may be counteracted. It leads directly to intensification which is the obvious means of increasing the supplies of foodstuffs in keeping with the needs of a growing population, when the area of productive land is limited. It is quite possible that enormous developments will take place in the use of artificial fertilisers in the near future, with consequences that cannot easily be foretold. Fifthly, scientific and technical progress is being made in animal husbandry and in other branches of agriculture which, in a number of special developments, tends to increase the net output per acre of land employed. It may be sufficient to mention under this head the gradual eradication of plant and animal diseases, improvements in the strains of cultivated plants and in the breeds of domestic animals, and the steadily increasing technical knowledge of the average farmer.

Against the general growing charges for labour in the production of animal foodstuffs may be set, first, the increasing use of machinery in dairying and in the preparation and manufacture of a number of different articles in this class of foodstuffs, and second, the spread of co-operation in production and marketing.

To what extent the sum total effect of these various ameliorating factors will be successful in counteracting the effect of the general factors that make for a rise in the cost of production and in the market prices of animal foodstuffs is a difficult question to answer. It will be noted that there is nothing to counteract the charges for capital which constitute a serious and growing item of expense in the production of animal foodstuffs, in the economic stage that is now being entered upon. On the whole, these factors are hardly likely to prevent an upward tendency (independently of any special conditions created by the European War) in the relative price of animal foodstuffs for some years to come.

The future movements in the price-level of animal foodstuffs depend especially upon the intensity of the demand for them among white populations, and this in its turn upon the level of the general purchasing power. As is shown below, the cost price of animal foodstuffs per unit tends under the present conditions to increase sharply with a rise in the per capita consumption and *vice versa*.¹ If the population of Europe find themselves poorer after the war they may reduce their consumption of these articles, and the result would be to lower their prices somewhat rapidly.

¹ See Part II. Chap. v.

On the other hand, the masses of the Western European populations may be better off than they were before the war, in which case the contrary results would tend to follow. The discussion of price movements in relation to intensification is reserved to the close of the present chapter.

With regard to the actual costs of production of animal food-stuffs, it is very difficult, owing to the diverse nature of the products, to the manner in which the different forms of production are intermingled and in which animal industries, as a whole, or separate branches are combined with other forms of agriculture, to arrive at anything approaching standard costs in regions of mixed farming.¹ In this respect animal foodstuffs differ materially from the chief cereals, for which, particularly in the case of wheat, the entire costs of production in important producing regions, can be, and have been, calculated. This, however, is possible for the production of meat under the simple pastoral system or when the entire resources of the farm are devoted to the production of the single commodity. In studying the total costs of production to individual producers, it should be noted that with the rapid rise in land values since 1895 many farmers in the newer countries are working with land that cost them less than the present market value. Their actual costs of production, other things being equal, are therefore correspondingly below the normal. Sometimes, indeed, these farmers have regarded their wheat or meat as a kind of by-product and have looked to the appreciation of land values as the chief reward of their exertions.² If in the future land values cease to rise rapidly, this feature will gradually disappear with the transfer of land to new owners.

Owing to the complexity of animal industries, especially where they enter into a system of mixed farming, the amount of exact knowledge concerning the ordinary costs of production is meagre. Small producers engaged in mixed farming are notorious for their neglect in keeping accurate accounts. Many of them probably have themselves no clear idea how the various items in the costs of production of their miscellaneous animal products stand together. Indeed the average farmer of this type, producing some beef cattle and calves as well as milk, pigs, and poultry, all partly on farm-grown and partly on commercial feedstuffs, would require a very elaborate system of account-keeping, with numerous debits and credits; in order to show with exactness the cost of each article of produce. It is obviously much easier to arrive at the costs of production when the business is conducted on a large scale and when attention is directed to one or two articles of animal food-stuffs only. Accounts have been kept by farmers in these circum-

¹ "It is doubtful if it is possible to determine the cost of any one commodity produced on the farm without a complete calculation of all costs."—C. S. Orwin, *Journal of Board of Agriculture*, June 1914, p. 200.

² See Marshall, *Principles* Bk. V. Chap. x. para. 2.

stances in which the costs of production are shown with considerable accuracy. The best results, however, are those based upon material collected by Experimental Farms, Agricultural Colleges and Departments of Agriculture in Europe and North America and published by them. The purpose has generally been to ascertain the comparative profitableness of various types of farming, and, incidentally, the net costs of production of separate articles under selected conditions or under the average conditions of a district have been obtained.¹

In the United States it is known that the cost of raising pigs and of fattening cattle depends mainly upon the market price of maize, or upon its cost of production if grown on the farm; and when pasturage is allowed for according to rental value, and the charges for labour, for breeding-stock and for general overhead expenses are debited to the account, the entire cost of raising pigs and cattle to a finished condition can be determined with sufficient accuracy. From this the producer's cost per pound of beef and pork can be readily obtained. It has been ascertained that dairying, especially when the milk is sold for town consumption, can be conducted with profit on much higher-priced land than is possible when the entire resources of the farm are devoted to the production of meat or of ordinary crops; that where there is a large and well-assured market for particular kinds of animal foodstuffs, highly specialised breeds of animals may yield the best results, and that elsewhere general-purpose animals may be more profitable. This simply means that the items in the cost of production vary according to locality, and that the scheme of production has to be modified accordingly.

Obviously differences in soil and climate, in the nature of other established industries, and in the traditions and character of the people themselves, will give rise to variations in essential features of the animal industries from one region to another throughout the world. Illustrations are numerous. Thus the production of poultry and eggs is associated with cereal cultivation or with ready supplies of cereals by sea, together with certain habits of care and diligence on the part of the people. As cereal regions are much more numerous and extensive than poultry-rearing regions are, it appears that the human factor in this industry is a most important one. Pig-rearing may be conducted primarily either for the production of bacon as in Denmark, Ireland and Eastern Canada, or for the production of the laid type of animal as in the United States and Germany; in the first case the foundations are an extensive butter-making form of dairying, yielding an abundance of skim-milk, together with cheap supplies of such feedstuffs as barley either of home production or imported, while in the second case an abundance of cheap fattening materials, such as maize or

¹ The following publications of the U.S. Department of Agriculture serve as illustrations of this kind of work: *Bulletin* 49 (1914); Bureau of Animal Industry, *Bulletin* 131; *Farmer's Bulletin*, 811; Bureau of Statistics, *Bulletins* 48 and 73; Office of Secretary, Report No. 111.

potatoes, is the basis. On all cereal-producing farms a limited amount of grain forms a by-product that has little market value. Hence animals such as pigs and poultry that consume gleanings and waste products may be regarded as themselves an indirect by-product of crop-cultivation. In the dairy industry, where the milk is sold for town consumption or is converted into cheese, the calves may represent a by-product and may be sold for rearing and fattening elsewhere, or may be converted into veal as soon as possible. Cattle may be kept on a farm simply as a means of disposing of the rough fodder in the most economical way or of assisting in the maintenance or the restoration of fertility without the production of animal foodstuffs becoming a special end in view. Sheep may be reared principally for wool or for mutton, or the combination of both wool and mutton-producing qualities may be aimed at. Goats are raised in different countries for meat, milk, skins and hair, but generally speaking not more than two of these can be obtained in satisfactory quality from the same class of animal.

A consideration of these facts leads to an important proposition with regard to the costs of production of the various kinds of animal foodstuffs. Except in the more undeveloped parts of the newly-settled countries of the world, where large-scale and somewhat uniform methods are the rule, the cost of production of any particular kind of animal foodstuffs depends to a considerable extent upon the price realised for another or other products of the producing animal. Sometimes even, when the keeping of food animals is distinctly subsidiary to crop-production, the costs of production of the foodstuffs obtained from them become quite nominal. In the dairy industry relations of interdependence as affecting the ultimate costs of production are especially marked.¹ Any attempt to estimate the true costs of production of animal foodstuffs under ordinary conditions involves the investigator in a study of the costs of production of the farm output as a whole, and of the manner in which these costs are correctly to be distributed among the various articles produced. Only by examining carefully the working of a number of farms and by collecting and averaging the results can an approximate standardisation of costs be obtained for a selected area.

When the costs of production of different classes of animal foodstuffs are examined, it is found that more or less definite relationships can be established between some of them. The total cost of production of milk has been obtained in a number of districts in different countries, and from this the cost of producing butter and cheese is readily obtained by adding the expenses of manufacture

¹ The actual costs of production of butter may be modified by the price realised for a finished product such as bacon arising from a complementary industry that utilises the skim-milk by-product. Dairying in any form results in the production of meat in various ways as a by-product (see Part II., Chap. v., Sec. 3), and this must be allowed for.

and deducting the value of the by-products.¹ Further, the cost of producing milk may be used as a kind of common denominator for estimating that of meat, because it is known fairly accurately how many beef cattle, or even how many sheep, a pasture farm will carry that produces a given quantity of milk as a dairy farm. This system of establishing equivalents can be extended by allowing for any differences in the quantities of commercial feedstuffs purchased. Thus, according to data furnished by experiments conducted in England,² it would appear that on good land the equivalent in milk production for 1 lb. of beef produced is about 14 lbs. However, since the labour involved in the production of milk is greater, the cost of producing 1 lb. of beef would approximate that, say, of 12 lbs. or nearly 5 quarts of milk, which would yield rather less than $\frac{1}{2}$ lb. of butter or $1\frac{1}{4}$ lbs. of cheese. The cost of producing butter and cheese depends naturally in some degree upon the value assigned to the skim-milk and whey; the former is sometimes sold for human consumption, but both are mainly consumed by pigs and calves, and the values to be set upon them may be calculated from the market cost of those quantities of commercial feedstuffs, of which they have an equivalent feed value. For such a calculation all the necessary data exist. Finally, the cost of producing pig-meat can be obtained by using these values for the by-products of dairying together with those of any concentrated feedstuffs used. The above method illustrates one that may be usefully employed in estimating the costs of production of different animal foodstuffs in mixed farming.

The future welfare of the consuming populations demands that the supplies of animal foodstuffs should be reasonably abundant and cheap. It does not appear, however, that these foodstuffs can be produced as cheaply in the immediate future as they have been in the past, for reasons that have been indicated. Obviously much depends upon the manner in which the world's productive resources as a whole are reorganised at the close of the present war. General prosperity inevitably leads, in Europe at any rate, to an increased per capita consumption of animal foodstuffs, which for its satisfaction now requires the wider use of intensive methods of production. The areas throughout the world that can be profitably used only for rearing food animals on the extensive system are not very great in proportion to the whole productive area. They are confined mainly to mountainous and broken regions, which naturally have a low average productive capacity, or to regions at present remote from the main lines of transport. There is little possibility, therefore, of a differential price arising for animal foodstuffs at a lower level than that for other classes of agricultural produce, that is to say, the production of animal

¹ About 1 gallon of milk is required to produce 1 lb. of whole milk cheese and about 2.7 gallons to produce 1 lb. of butter, the latter, however, varying according to the fat content of the milk used.

² See *Journal Board of Agriculture*, Sept. 1915, p. 531.

foodstuffs in the regions of mixed farming is not likely to be discouraged by the competition of cheap meat from purely pastoral regions. A consideration of the present conditions would seem to show that, when some undeveloped tropical highlands are set aside, the various food-producing animals have nearly reached the limits of their superficial distribution throughout the world, allowance being made for the areas reserved for food and fibre crops. It would appear also that in a number of temperate countries, a kind of saturation point in the density of such animals under existing methods has been reached. There is little doubt, however, that their density can be considerably increased under intensive methods.

It is to be hoped that the rapid spread of these methods in the temperate regions will not be long delayed, but it has to be recognised that a number of conditions exist that impede progress in this direction. There is still a feeling of insecurity among producers with regard to prices, especially as affected by tariff changes; the experiences of the past have not been reassuring. Sufficient supplies of capital at the command of farmers and the proper social organisation are too often wanting; the problem here is to devise means of spreading the repayment of the initial capital outlay over a number of years, by co-operative credit for example, so that the individual farmer does not need to seek short-time returns, which is a great evil under the present system of agriculture. The introduction of intensive methods, moreover, while obviously yielding a higher return per acre, does not, as above observed, necessarily mean a higher return per man. Again, elements of friction arise through the difficulty of modifying rapidly the systems of crop-rotation, through restrictive covenants with landlords, and through the common conservatism of farmers. Finally, rapid intensification, if it led to a sharp increase in the number of food animals reared, might cause a shortage to occur in the world's supplies of concentrated feedstuffs, accompanied by an undue rise in their market prices. It appears, therefore, that a revolution in the direction of establishing intensive methods would be impeded not only by the initial cost, but also by features inherent in the farming industry as a whole.

Conjecture with regard to the future, especially at the present time, may appear somewhat useless. This statement, however, at least seems warranted; that whatever happens, as compared with the pre-war price levels, the world-market prices of animal foodstuffs will tend to remain high relative to those of other commodities for some years to come.

Provided, however, that production is restored to its normal course of progress at an early date, so that no special hindrance is imposed to the spread of intensive methods of agriculture, it is possible, perhaps even probable, that the world's production of animal and other foodstuffs will be enormously increased by the end of the next decade. Since about the year 1900 consumers of foodstuffs have been paying a rapidly increasing toll to landowners,

owing to the increasing shortage of productive land. The better utilisation of the world's agricultural resources by intensification and by drawing upon the undeveloped wealth of the tropical regions, would tend to reduce this burden and prices may fall relatively, while still leaving a reasonable return to the actual producers. The introduction of more intensive methods, while costly at first, should ultimately cheapen the costs of production by increasing man's control over the forces of nature. In other words, as highly intensified agriculture under the progress of technical applications becomes more akin to manufacturing industries, the principle of increasing returns may be found to displace that of diminishing returns. The opinion is, therefore, ventured that if progress follows its normal course, within the next two decades agricultural production throughout the civilised world will be increased and cheapened. The first results of such progress would be to extend and cheapen the supplies of those foodstuffs that show the greatest elasticity in consumption, namely, animal foodstuffs.

PART II.—CONSUMPTION

INTRODUCTORY

IT has been shown in the first part of this enquiry that the production of animal foodstuffs throughout the world has increased only at a moderate rate in recent years, and that indications have not been wanting to show that consumption was overtaking production. Although with the exception of Siberia the rapid opening up of new and productive areas of agricultural land came to an end about the year 1900, the full effects of this curtailment were not felt till nearly a decade later; they are evident at the present time and will continue to be so in the immediate future. The position has been ameliorated in some measure by the fuller utilisation of already occupied lands consequent upon the extension of railways, and by a continuation of the processes of exhaustive cropping and overstocking on large areas of fertile land that had been under production prior to the year 1900, whose stores of fertility have not in the interval reached the point of threatened exhaustion.¹

Owing to the fact that the production of animal foodstuffs tends to be residual, the shortage of agricultural resources relative to population has been most marked in the matter of animal foodstuffs. The increased demand in the industrial areas of the Northern Hemisphere has tended to withdraw the whole surplus of animal foodstuffs from the newly-developed regions, with the final result that meat may become almost as limited for local consumption and nearly as costly in Buenos Ayres or Christchurch as in London, where a considerable advance in the price in 1913 failed to draw forth a corresponding increase in supplies.²

Although the outlook for increased supplies in the more distant future appears on the whole, as we have seen, to be quite hopeful, the prospects for the immediate future do not disclose the existence of any factors that are likely to add considerably to the world's output of animal foodstuffs. From this point of view a world-wide food problem tends to appear, and the study of the conditions that determine the rates of consumption of animal foodstuffs, and of the economic relations between the consumption and the production of these foodstuffs, requires special notice.

¹ In new countries it is necessary to distinguish between merely occupied and fully productive land. Much land in those countries has passed to private ownership and ranks as farm land, but either produces nothing, or only a fraction of what it might produce, even in the existing conditions of general development.

² See *Agric. Statistics*, Part IV., 1913 (Cd. 7551), p. 290.

It is the purpose of the following chapters to analyse the conditions that determine the consumption of animal foodstuffs throughout the world, and in special areas. The causes that lead to variations in the consumption of different classes of animal foodstuffs will require special attention. The broader questions, also, relating to the proportions of animal foodstuffs to plant foodstuffs in human nourishment will call for some discussion.

As has already been anticipated, the theory of a world-market for the more important classes of animal foodstuffs is assumed in this discussion. Such a market existed, with certain qualifications and exceptions, prior to the European War. Its existence is likely to become still more decided at the close of the war, when lines and means of transport are reorganised, and the possibility of any country continuing to have an economic life independent of the world's great markets more or less completely disappears. Local famines, formerly so common even in times of peace, are already rapidly disappearing, and will before long become largely things of the past. Tariff barriers, also, as relating to foodstuffs, seem destined to be swept away.

In the matter of terminology, it will be convenient to use the term "plant foodstuffs" to cover all articles of food derived directly from the vegetable kingdom, whether cereals, fruits, nuts, specialised crops such as potatoes and sugar, or garden vegetables. The terms animal foodstuffs, feedstuffs and fodders will be used as in Part I., above. Since meat in various forms is the most important and representative kind of animal foodstuffs, the peoples that consume animal foodstuffs to a considerable extent will, for convenience, be called meat-consumers; and those that live almost entirely on plant foodstuffs will similarly be called meat-abstainers. The term fish-consumers will explain itself.

Attention will be confined in this section, mainly to the consumption of animal foodstuffs, as distinct from the production of the same articles. In discussing the adjustment between consumption and production, however, the reactions of these upon each other will require to be noted; and some of the points and conclusions already stated in the section on production, will be re-examined in the light of the study of consumption attempted in the following chapters. Indeed, consumption and production in this field are so intimately connected that it is scarcely possible to discuss one of them without constant reference to the other. We shall see as we proceed that the interdependence of these two sides is a striking feature in the study of the economic questions relating to the important class of commodities that forms the subject of this enquiry.

CHAPTER I

THE CONSUMING POPULATIONS

AS has been already noted,¹ considerably more than one-half of the population of the world lives almost entirely upon foodstuffs other than those of animal origin. In this class stand practically the whole population of Asia outside Siberia, the native populations of Africa, a considerable part of the population of tropical South America² and the large aggregate population of numerous tropical and sub-tropical islands. Some uncertainty, however, exists as to the consumption of animal foodstuffs among the Chinese, who are known to raise great numbers both of pigs and of poultry,³ the produce of which enters chiefly into domestic consumption. In view of the enormous population it is nevertheless certain that the average per capita consumption is very low. The probability is that the majority of the people never taste meat other than poultry, and the latter but seldom.⁴ Eggs appear to be more widely consumed in China wherever poultry are raised.⁵ Among the Chinese, as among the rest of the populations above mentioned, dairy products are either unknown or are of inferior quality and are consumed in relatively small quantities.

The populations among which animal foodstuffs form an important part of the dietary are those of Europe and Siberia, temperate North and temperate South America, and Australasia, to which should be added the relatively small white population of South Africa. In the year 1911 the total estimated population of these regions was about 587 millions, of which 462 millions were in Europe and Siberia, about 105 millions in temperate North America,⁶ about 14 million in temperate South America,⁷ and about 5½ millions in Australasia, while the white population of South Africa amounted to less than 1½ millions. When allowance is made for the meat-consumers outside these areas, the total of 600

¹ Part I., p. 4.

² In tropical South America meat appears to be consumed in considerable quantities by the people of European descent, inhabiting the coastal districts and the highlands. The native and the mixed populations of the interior probably eat little meat other than game.

³ U.S. Dept. Agric. Office of Secretary, Bureau of Crop Estimates Report 109, 1916, p. 56.

⁴ See U.S. Daily Commerce Rept., Aug. 7th, 1911.

⁵ See Part I., Chap. iv., pp. 97, 98.

⁶ Some addition should perhaps be made for stock-rearing populations of Northern Mexico.

⁷ There are, besides, a considerable number of meat-consumers in tropical South America, as above observed. Animal foodstuffs are also consumed in Central America, including the Southern part of the Mexican plateau.

millions may be taken as representing in round numbers the animal-food consuming population of the world. Some important sections of the population of Eastern and Southern Europe, especially those that can rely upon large supplies of sea or river fish, consume little in the way of animal foodstuffs. On the other hand, the wealthier sections of the population of China, and perhaps also, under favourable conditions of supply, of other regions in the same class, may consume relatively large quantities of such foodstuffs. These two may be taken as roughly balancing each other, hence the total of 600 millions arrived at above may be taken as a fair estimate. If the entire population of the world is taken as amounting to about 1,600 millions, the meat-consumers would number well over a third of the whole.

Fifty years ago the total estimated population of Europe, North America and Australasia was less than 300 millions, while the regular meat-consuming population outside these continents was not more than 10 millions. The total of meat-consumers in the world at that time probably represented somewhat less than a quarter of the entire population of the globe.

There has clearly been a rapid increase in the meat-consuming population of the world during the last fifty years. This increase amounts, apparently, to over 90%, and some further allowance should also be made for the rise in the standard of living not only in Europe, but also in Asiatic and tropical countries. It is more difficult to ascertain with exactness the changes in the proportions of meat-consumers to meat-abstainers during the period, owing to uncertainties regarding the numbers of the non-European populations. The facts available make it fairly clear, however, that meat-consumers have increased more rapidly in numbers than meat-abstainers. The latter, in any case, have been largely self-contained in the matter of foodstuffs, and have not had, nor are likely to have, any notable surplus of animal foodstuffs available for export. They may for a time increase their exports of cereals and feedstuffs, but should the standard of living rise among these peoples, such products may in certain cases be retained for home consumption.

The rapid increase during the last fifty years in the white population of the world (and in certain coloured populations under European rule) has been due to several causes. The less frequent occurrence of devastating wars and pestilences as compared with earlier times, was perhaps the most effective cause. The opening up of vast new regions of great agricultural productiveness,¹ encouraged the growth of white population outside Europe; while the development of cheap transport, enabling the surplus foodstuffs and feedstuffs of these new regions and of tropical and sub-tropical countries,² to be carried economically to other regions, to supple-

¹ For details, see Part I., Chap. iv.

² See Part I., Chap. v.

ment local supplies otherwise deficient, was of great effect in making large increases in the industrial populations in Europe possible. It is only in quite recent years that technical developments have been of marked effect in increasing the returns per acre from occupied land.¹ In the main, however, a survey of those fifty years shows, as we have seen, that the increasing meat-consuming population of the world was utilising hitherto undeveloped areas of land in order to obtain the additional supplies of foodstuffs required, rather than seeking to do so by making already occupied land more productive.²

The increase in the total population of the world and of the meat-consuming population, that has continued during the last fifty years, does not make it appear that there will be a marked slackening in the rate of increase in the near future. Even under a diminished *rate* of increase, the greater totals produce a relatively large increase in absolute numbers; thus an increase of 1% in the present population of the United States means an addition of over one million persons to the population, while fifty years ago an increase of about 2½% was required to produce the same absolute addition to the numbers of the population. From the point of view of this enquiry, it is apparent that the problem of producing food supplies sufficient in quantity and quality to meet the growing needs of the world's population, still exists. In the last resort it is a question whether the human control over natural resources for food production will be effective in maintaining the increases in produce of different kinds required to meet the growing needs of increasing population combined with higher standards of living.³ Failing this, widespread modifications in the dietary may become necessary in the future; the concentrated animal foodstuffs, which are more costly in agricultural resources, may have to be replaced to some extent by the less concentrated plant foodstuffs.⁴

A more detailed examination of the rates of increase in the populations of the various meat-consuming regions, during the ten years from 1901 to 1911, throws light upon the present tendencies.

¹ This has arisen through improvements in farming methods due to the advance of agricultural science; in general, widespread improvements have taken place in stock-breeding and in the manufacture and utilisation of commercial fertilisers and feedstuffs, in the latter of which the cheapening of transport has played an important part.

² This is especially true of the Anglo-Saxon peoples. Those of Germany and certain neighbouring countries were rather an exception in this matter.

³ See Part I., Chap. xii. With reference to the dependence of human progress in the future upon agricultural production, see J. Russell Smith, *Industry and Commerce*, p. 262, where it is stated that the comfort of human populations in the future probably depends more upon commercial fertilisers than upon iron and coal.

⁴ For a discussion of this question, see Chap. iii., below.

TABLE SHOWING THE ESTIMATED MEAT-CONSUMING POPULATIONS OF VARIOUS REGIONS IN 1901 AND 1911 AND THE PERCENTAGE INCREASE.

	1901 MILL.	1911 MILL.	% IN- CREASE.
<i>Europe</i>	403.7	453.2	12.26
(1) Eastern Europe ¹	155.8	183.4	
(2) Western Europe ²	174.0	190.5	
(3) Southern Europe ³	58.6	62.5	
(4) Scandinavian Countries and Holland.....	15.3	16.8	
<i>New Regions</i>	107.7	134.3	24.7
(1) North America ⁴	86.2	104.8	
(2) Southern Hemisphere ⁵	15.5	20.8	
(3) Siberia	6.0	8.7	
World's Total	511.4	587.5	15.

The most striking fact brought out by a study of these figures is that the rates of increase for all the newer regions outside Europe are much greater than that for Europe. This fact is of added significance when it is remembered that the per capita consumption of meat and meat products in these regions is double that of the average in Europe.⁶ Moreover, the extra-European population has considerable weight in the total since it accounted for about 134 millions out of a total of about 587 millions in 1911, that is approximately 23%. Its absolute increase in the ten-year period was sufficient to raise the European increase of 12¼% to about 15% for the whole meat-consuming population in the same period.

The populations of Europe constitute the most important part of the meat-consumers of the world, and it is necessary to examine them by groups somewhat closely, so as to get a clearer view of the final tendencies in consumption; since the per capita consumption of animal foodstuffs varies from group to group, the rates of increase in the populations comprising these different groups require to be noted also.

¹ Includes Russia (with Poland, Finland and Caucasia), Hungary, Roumania and Bulgaria.

² Includes the United Kingdom, Germany, Austria, France, Belgium and Switzerland.

³ Includes Spain, Italy, Portugal and Greece.

⁴ Includes the United States, Canada and Northern Mexico, for the last of which an estimate of one-fifth of the population of Mexico has been taken.

⁵ Includes Argentina, Chile, Uruguay and coastal Brazil, for the first of which again an estimate has been taken, together with Australasia and South Africa (white population only).

See table, p. 205 below.

For the purpose of this analysis, it is convenient to divide Europe into three main sections, namely, Eastern Europe, Western Europe, and the Mediterranean countries. The first of these, which contains over one-third of the population of the continent, has a comparatively high rate of increase in the population, but a relatively low per capita consumption of animal foodstuffs. Western Europe may be sub-divided into two sections; the very important and predominantly industrial area comprising the United Kingdom, Northern France, Belgium, Germany and Northern Austria; and the Scandinavian countries, to which Holland may be added. In the former, containing about two-fifths of the population of the Continent, the rate of increase in the populations is moderately rapid, and the per capita consumption of animal foodstuffs relatively high, while in the Scandinavian countries with Holland, which together contain but a small population (about $\frac{1}{7}$ of the whole continent) the rate of increase in the population, and the per capita consumption of animal foodstuffs are both but moderate. In the Mediterranean countries the rate of increase in the population, and the per capita consumption of animal foodstuffs are both on the average rather low.

It thus appears that in Western and Mediterranean Europe the most rapid increase in population has taken place in the area of greatest population, where also the per capita consumption of animal foodstuffs is above the average for the continent. So far as this section of Europe is concerned, therefore, the result has been to produce a higher average per capita consumption for the increased population, independently of any changes of the local standards of living.

In Eastern Europe the rate of increase in the population has been more rapid than in the rest of the continent, and the per capita consumption of meat, at any rate, is said to be low.¹ The probability is that the consumption of poultry and eggs in this vast region is considerably in excess of the European average, and this would compensate in some measure for the obviously low meat consumption. The Russian is known to be fond of meat, and will probably consume a great deal more than at present if his economic conditions permit it. The existence in Eastern Europe of this huge population, with a per capita consumption of animal foodstuffs capable of rising considerably under favourable circumstances, is a factor that has to be reckoned with in considering the future outlook. The evidence available as to changes in the Russian per capita consumption of animal foodstuffs in recent years points to the supposition that it has increased.

When the average per capita consumption of all animal foodstuffs throughout Europe is considered, there is reason to believe

¹ The estimate usually quoted for Russia is that of Mulhall for 1899, namely, 50 lbs. per capita; that for Austria-Hungary, that of Ostertag for 1890, namely, 64 lbs. per capita, as compared with 115 to 120 lbs. in the United Kingdom.

that during the first decade of the 20th century there was some tendency for it to increase, which, however, weakened after 1907. Limitations have existed in the quantities of supplies available, and in the purchasing power of the poorer sections of the populations of the various countries. In general a "saturation point" has been far from being reached, and least so in Eastern and Central Europe. It would appear that in the near future the same conditions will operate, and that the average per capita consumption of animal foodstuffs throughout Europe will tend to increase, subject to the limitations imposed by the supplies available and by the purchasing power of the wage-earning classes. That this is the case is borne out by the fact already noted, that the average European per capita consumption is much below that of the new countries, where breadstuffs as alternative foodstuffs are at least as plentiful as in Europe, though, on the whole, more expensive in the prepared forms in comparison with meat.

Concerning the per capita consumption of animal foodstuffs in the newer countries during the first ten years of the present century, the evidence available points to a tendency for that of meat to fall somewhat, while that of dairy and poultry products has apparently risen. The decline in the per capita meat consumption since 1900 has apparently been in continuation of a process in operation in these countries, since the time when the introduction of the refrigerated transport of meat made local supplies of the latter a valuable article in international commerce. It is doubtful, however, whether in spite of some fall in the per capita meat consumption in these countries there is any distinct tendency for the per capita consumption of all animal foodstuffs combined to decline at present. On the whole, it is to be observed that the per capita consumption of animal foodstuffs, taken together, rose rather than fell among white populations in the period 1900 to 1911; and this has been due mainly to the more rapid increase in the populations of the new countries and of the industrial areas of Europe, having a high average per capita consumption.

It is quite possible also that emigration will be unusually heavy from some parts of Europe to the newer countries in the years following the close of the present war. The effect of this would probably be to increase the world's average per capita consumption of meat and other animal foodstuffs by the mere transference of population from countries of relatively low to countries of relatively high per capita consumption. Since also the emigrating population usually consists mainly of the more able-bodied men and women of marrying age, the effective additions to the populations of the newer countries thereby made in the space of some years are greater than are represented by the actual numbers that emigrate.

The remaining and non-European populations living in the temperate regions, whether mainly pastoral or mainly agricultural in their occupations are, generally speaking, at present in a backward state of development. They contain some proportion of

nomads and semi-nomads, largely self-contained in the matter of food supplies, whose per capita consumption of animal foodstuffs may be relatively high. Any advance towards a more advanced stage of development and standard of living among them, while possibly involving an increase in their total consumption of animal foodstuffs, is likely at the same time to result in, if it does not indeed result from, an increase in the surplus quantities of animal products such as wool, skin, hides, and perhaps even foodstuffs, available for exchange trade with the rest of the world.

CHAPTER II

THE RATE OF CONSUMPTION

(a) MEAT.

MEATS of various kinds, and meat products, have always formed the most important item among the animal foodstuffs in ordinary human consumption, and they still do so. Other foodstuffs of animal origin, taken together, represent a greater food value and cost more in the average national food budget than is generally supposed.¹ Moreover, the consumption of the latter group tends to increase in proportion to the meat group in countries of large urban populations. Notwithstanding this fact, meat is still the typical form of animal foodstuffs, and the rate of meat consumption is a fair criterion of the extent to which animal foodstuffs as a whole are consumed.²

It is only in a few countries that attempts have been made to obtain tolerably accurate statistics for meat consumption, and in still fewer that the consumption of the other animal foodstuffs has been ascertained with any degree of exactness. Concerning the variations from year to year there is naturally very little information obtainable. Estimates have been made at different times of the meat consumption in most important countries, but some of these are out-of-date and others untrustworthy owing to the scanty statistical information upon which they were based. In countries that are predominantly agricultural and that have poorly organised departments of agricultural statistics it is clearly impossible to do more than make a rough estimates of the total consumption of animal foodstuffs; much is consumed on the farms or sold in small parcels to local dealers and to neighbouring market towns, concerning all of which little account is kept by the producers. In this connection it is to be observed that much more accurate

¹ In the United Kingdom in 1911 the total value of the meat consumed has been estimated at about £128 millions (Rew), while the total value of the other animal foodstuffs consumed in the same year cannot have been much less than £100 millions. In the United Kingdom for the five years 1908-13 the average energy value of the meat of all kinds (including poultry and game) consumed has been estimated at 8,508,000 million cal., and that of the dairy produce and eggs at 7,541,000 million calories (Cd. 8421, App. I.B.), Prof. T. B. Wood (National Food Supply, p. 8) gives the percentage of the total energy value supplied by meat of all kinds as 18% and that supplied by dairy produce as 15% in the United Kingdom, 1909-13.

² In practice all animal industries lead to the production of meat in some form, either directly or indirectly. It is almost impossible to produce other animal foodstuffs without at the same time producing certain relatively large quantities of meat, and conversely there are but few important meat-producing areas that do not at the same time produce considerable quantities of milk or eggs or both.

information is available concerning the production (and the consumption) of cereals and other crops. Not only is such information eagerly sought for by the world's great produce markets, but it is more easily collected and recorded, since every farmer and peasant knows fairly accurately his acreage under different crops, and the collecting of all the produce at harvest times makes it easy to arrive at the total yield.

In three important countries, however, namely, the United States, the United Kingdom, and Germany, the per capita consumption of meat and meat products for recent years has been fairly accurately ascertained, so that variations in the consumption from year to year can be studied. The same is true to a more limited extent of the per capita consumption of butter, cheese and milk. The per capita consumption of margarine, it may be noted, can be obtained with great accuracy owing to the concentration of production in a limited number of factories. Fairly accurate figures for the per capita consumption of the various animal food-stuffs are available also for some countries of smaller population, as, for example, Canada, and in addition for a number of cities in countries where complete statistics for the whole population are wanting. With the assistance, therefore, of such estimates as have been made concerning the per capita consumption in these latter countries it is possible to form some idea of the figures for most meat-consuming countries. It must, however, be understood that such figures vary in value, and that some are used under this reservation in default of more accurate official information.

It is necessary for the proper interpretation of statistics of meat consumption to distinguish between dressed meat and dressed meat plus edible offal. The latter is said to be nearly 18% of the dressed weight of cattle, sheep and swine.¹

Except in the case of the United States, where the weight of the extra-edible parts has been detailed separately in the statistics of consumption, it appears that the official figures (or the estimates) of meat consumption available for most countries refer to dressed meat only. Some addition should accordingly be made in order to arrive at the total weight of meat consumed for these countries. This addition would require to be greater for the meat-exporting than for the meat-importing countries, since when carcasses are prepared for export as frozen or chilled meat the extra edible parts are separated and are often retained in the exporting country. Certain parts, especially the tongues, are tinned and exported from

¹ U.S. Dept. of Agric., Bureau of Crop Estimates, Report 109, p. 129.—This is the average for the United States. The proportion of extra edible parts to dressed weight is presumably lower for sheep and pigs than for cattle. The average percentage of edible offal to dressed weight would therefore be greater when beef forms a larger proportion of the total meat consumed and the proportions of beef, mutton and pig-meat consumed vary greatly from one country to another. Lard, fats, oils (except commercial tallow) are usually entered under the head of meat products and appear in consumption as meat.

the surplus-producing countries. Large quantities of other extra edible parts have in recent years been consigned from North and South America to the United Kingdom, where, as in other parts of Europe, they are consumed largely by the poorer classes of the population.¹ On the whole, however, there appears to be a considerable waste of extra edible parts in the more distant surplus-producing countries, owing to the absence of markets for their disposal.

The statistics of dressed weight meat consumption, apparently, do not include anything but the flesh of cattle and calves, sheep and lambs and goats. Horseflesh and poultry are therefore excluded, so also are rabbits and game. The additions to the meat supplies from these two sources vary greatly from one country to another. There is an enormous output of poultry meat in the great surplus-producing cereal regions of North America and Russia; while the great meat-producing regions of the Southern Hemisphere produce comparatively small numbers of poultry. Domesticated rabbits are an important article of food in Belgium, and rabbits of all kinds are probably consumed in greater per capita quantities in Europe than in the newer countries where wild rabbits, though often extraordinarily numerous, are apt to be despised as an article of food. The resources in game² available in different countries vary largely with the area of forested and otherwise unoccupied land. Such resources tend to be greater in the newer countries for obvious reasons, but prairie lands and open plains in any case soon become depleted of game. Certain parts of Europe, however, owing to natural or to artificial conditions are rich in game of special kinds. With the increase in population and the progress of settlement and cultivation the supplies of game available for consumption in various countries are declining, and as the rearing of game is scarcely adapted to intensive methods of production, it appears likely that game will diminish further as an item in the food supplies of meat-consuming countries.

Owing to the fact that only a small percentage of the total game meat passes through the ordinary market channels in most countries, it is difficult to estimate the quantities consumed per capita. In general, it may be said that game, like poultry, is consumed as an additional form of meat mainly by the wealthier classes, at any rate, in the countries of Europe, just as extra edible parts of meat-producing animals are consumed as a substitute for dressed meat by the poorer classes. It is obvious that the per capita consumption of all forms of meat, including extra edible parts, poultry and game, is considerably greater in most countries than that of dressed

¹ For some account of the British import trade in edible offals, see Cd. 2644 QQ. 3949-54.

² Under this head are included various species of wild birds, deer, wild pig, hares, and the various flesh-yielding animals peculiar to different countries such as the kangaroo of Australia, the moose of Canada, and the antelope of South Africa.

meat alone. The additional supplies from these sources may amount to 25% of the dressed meat by weight on an average of countries, and of this about 7% may be due to poultry and game. Under the existing standards of consumption among the wealthier classes a considerable addition to their supplies of ordinary dressed meat would be necessary in the absence of these items. The bearing of increased population and of the consequent extensions of agriculture upon the supplies of game meat available in various regions is, therefore, a matter that cannot be entirely overlooked.

It appears from the facts stated in the above paragraphs that the figures for the per capita consumption of meat in various countries are only an approximate guide, and that further enquiry is really necessary in each case to ascertain the corrections necessary before they can be taken as strictly comparable. The following table ¹ shows in a summarised form the facts hitherto collected concerning the per capita meat consumption in various countries.

Country	Year	lbs. per cap. ²	Country	Year	lbs. per cap. ²
Australia	1902	262	Belgium	1902	70
New Zealand ...	1902	212	Netherlands	1902	70
United States ...	1909	170·6	Greece	1899	68
Argentina	1899	140 ³	Austria-	1890	64 ⁴
			Hungary		
Canada	1910	138	Norway	1902	62
Cuba	1906	124	Russian Poland	1899	62
United Kingdom	1910	115	Sweden	1902	62
Germany	1913	112	Russia	1899	50
France	1909	99	Spain	1890	48
Denmark ...	1902	76	Italy	1901	46·5
Switzerland	1899	75	Portugal	1899	44

The average per capita consumption of meat among the meat-consuming populations of the world, as above defined, has been estimated at 93·3 lbs.⁵ This would appear to represent the minimum normal quantity under ordinary conditions in a temperate climate for a liberal and balanced diet. It requires, however, to

¹ Taken largely from Report 109. U.S. Dept. Agric., Bureau Crop Estimates (p. 132).—More recent figures have been substituted for those given for the United Kingdom, France and Germany.

² Presumably dressed weight and exclusive of poultry and game in all cases.

³ Obviously an under-estimate.

⁴ Unreliable, because not sufficiently recent.

⁵ U.S. Dept. Agric., Bureau Crop Estimates, Report 109, p. 16. The same Report estimates the total annual production of dressed meat of the world, exclusive of China, at about 50,000 million lbs. If, however, the total consuming population is upwards of 600 millions, as estimated above, the average per capita consumption would be only 83 to 84 lbs.

be supplemented by supplies of other forms of animal foodstuffs in addition to cereals, fruits, and other vegetable foods.¹

The above table shows that there exist great differences in the per capita rates of meat consumption in different countries. The greatest extremes occur between the countries placed at the head and those placed at the bottom of the table. The two first, namely, Australia and New Zealand, have an extraordinarily high meat consumption, due to the great abundance of local supplies coupled with but moderate supplies of poultry products, and relatively small supplies of fish.² The quantities of meat consumed in these countries are probably excessive, and the per capita rate is more likely to diminish than increase with the growth of a more complex standard of living.

The United States, in spite of a recent decline,³ still shows a high per capita rate of meat consumption. The American consumption of poultry products, dairy products and of fish is also considerable.⁴ The causes of this great consumption of animal foodstuffs by the population of the United States are, firstly, the habits of living derived from earlier times of great abundance, and secondly, the prevailing high level of incomes and wages. This high standard found in the United States affords, as already noted, some indication of the possible increases in less favoured countries should the general purchasing power and the extent of the available supplies permit it.

¹ If 3,400 calories in energy value of food be taken as the minimum requirement per man per day and 100 persons of mixed population be taken as equivalent to 77 men, then the minimum requirement for a mixed population would be 2,618 calories. The equivalent of 93 lbs. of meat in calories per day would be about 380 calories, or about one-seventh of the total requirements. Meat, however, is a concentrated form of food and supplies a peculiarly stimulating effect upon living cells. The above calculation is based on data found in the Report of the Food Supply Committee, 1917 (Cd. 8241).

² The per capita consumption of fish in Australia has been estimated at 9 lbs. per annum against 42 lbs. in the United Kingdom.—Commonwealth Yearbook, No. 9, p. 397.

See also Dominions Commission Final Report (Cd. 8462), p. 55, and Note. The fish consumption in New Zealand is about 5 lbs. per capita compared with 25 lbs. per capita in Canada (Cd. 8462), p. 56.

³ The estimated consumption of meat in the United States (exclusive of edible offal) has been given as follows in lbs. per capita.

1900	...	...	...	...	179.2
1909	...	...	...	...	172.3
1914	...	...	...	...	151.9

U.S. Dept. of Agric., *Farmer's Bulletin*, 575. The figure for 1900 is slightly under and that for 1909 slightly over the corresponding figures given in Report 109 (see table above).

⁴ The American consumption of butter in 1909 was about 17 lbs. per capita and of cheese about 4 lbs. per capita. The per capita milk consumption was 50–70 gallons per annum on the farms, and 28 gallons per annum in towns over 2,500 population. The value of the poultry products consumed was about £1.5 per capita and the fish consumption was about 20 lbs. per capita. The corresponding figures for the United Kingdom were approximately as follows:—butter, 16 lbs.; cheese, 7 lbs.; milk, 23 gallons; poultry products rather more than 10/- per capita; fish, 42 lbs.

The position of Canada in the matter of consumption of animal foodstuffs is similar to that of the United States, though the scale is not so high. Fish is consumed in greater quantities per capita than in the United States, dairy products at least in equal quantities, while the per capita consumption of poultry products, though considerable, is somewhat less by values.

The per capita consumption of meat in Germany and the United Kingdom is well above the world's average, taken at 93 lbs., while that of France is slightly so. In each of these countries, in spite of considerable supplies of fish and of dairy and poultry products, there is little doubt that the rate of meat consumption is capable of great expansion among the masses of the working-class population, given adequate purchasing power and sufficient supplies. Some evidence of this appears in the fact that in these countries the consumption of meat and other animal foodstuffs tends to rise in times of industrial prosperity and to diminish in times of depression.¹

With regard to the remaining countries in the above table, if the per capita figures are accepted as they stand, it is apparent that the meat consumption is for one reason or another unduly low. The principal cause in all of them is the relative poverty of the masses of the population resulting in habitual low standards of living among them.²

In the Mediterranean countries, in addition to general poverty resulting from a backward state of economic development, further causes contributing to a low per capita consumption of animal foodstuffs appear in the relatively warm climate which renders animal foodstuffs less necessary, in the wide use of olive oil and its substitutes in the place of butter and lard, and in the general accessibility of most centres of population to fishing waters. Meat tends to be an accessory in the diet rather than a necessity; and fruits, nuts and vegetable oils, which are widely produced, and which are regarded as accessories elsewhere, tend to replace meat and animal fats as staple articles of food.

In other countries in this group distinguished by a low per capita consumption of meat, such as Russia and the Scandinavian countries, fish is a very important article of diet, and the large quantities consumed make meat less essential; in Russia enormous

¹ Schmoller, *Grundriss der Allgemeinen Volkswirtschaft*, p. 603. With reference to the United Kingdom in particular, see (Cd. 2644), QQ. 388, 389. It appears from investigations made in these countries that a considerable fraction of the population has been chronically more or less under-nourished; and it is an interesting speculation whether an increased outlay on concentrated foodstuffs, such as those of animal origin, would not before long result in a more than proportionate increase in the value of the industrial output.

² These populations are found mainly in those predominantly agricultural districts of Europe where climatic conditions are often unfavourable to animal industries and where agriculture tends to be in a backward state. Local supplies of animal foodstuffs are consequently insufficient to produce more than a meagre per capita supply, and the low purchasing power of these populations prevents them from competing for foreign surplus supplies.

supplies of fish are obtained from the great rivers,¹ and poultry produce is abundant;² while in the Scandinavian countries sea fish are probably more extensively consumed per head of the population than in any other considerable region of the world except Japan.

The position with regard to the per capita rates of meat consumption, as described above, cannot be regarded as fixed in the different areas considered. Changes may take place rapidly in the near future owing partly to the disintegrating effects of the present war. It is interesting to note that the tendencies are towards higher standards of living for the masses of the populations on the whole, and this would foreshadow an increase in the general rate of meat consumption, apart from any increase in the populations themselves. It has been already shown in Part I., above, that the world's supplies of meat are at the present time limited as to their rate of expansion; large and rapid increases in these supplies would be forthcoming only at a considerably enhanced price; and this price increase would necessarily affect other articles of agricultural production as well. In the last resort a largely increased consumption of meat in any populous area or throughout the civilised world seems to depend now, as already shown, upon the use of more efficient and cheaper methods of production, affecting either agriculture or manufacturing industries, or both.³

(b) DAIRY PRODUCTS.

The butter consumption of the world has advanced with the growth of population and prosperity, but the pressure of demand upon supply has not been felt to the same extent as in the case of meat. The production of butter has been more elastic than that of meat,⁴ the transportation of the finished article is cheaper in proportion to value, and substitutes have been more readily found.

From the general point of view any reduction in the meat consumption of a given population tends to increase its consumption of butter and butter substitutes owing to the consequent increase in the consumption of bread with which some form of fat, generally butter, among European peoples, is customarily used.⁵ It is

¹ The output of the Russian fisheries in 1911 has been estimated as over 708,300 tons, nearly all of which was fresh-water fish.—*Journal Royal Stat. Soc.*, March, 1917, p. 198.

² See Part I., Chap. iv., p. 86.

³ This question is discussed in detail in Chap. iv, below, pp. 239-243.

⁴ The total exports of butter from surplus countries in 1911 were 719.6 million lbs., while the corresponding total averaged 610 millions for the years 1902-6. This makes an average increase of about 2½% per annum for the years 1904-11, which should be compared with the corresponding increase of about 1½% in the total meat supplies exports. See p. 104, note 1.

⁵ A decline in the meat consumption would imply also a decline in quantities of animal fats available, and would tend to cause an increase in the consumption of other forms of edible fats.

known that the per capita meat consumption of certain large populations in Europe, as well as in North America, showed some decline in the period 1907-13. Now it is not generally held that the standard of living declined in these countries to any extent in the same period. One of the ways in which the standard of living was maintained in face of a growing meat shortage was by an increased use of dairy products,¹ among which butter, with its substitutes, ranks as the chief.

The fact that the production of butter has been comparatively elastic in recent years has been due to two main conditions in agricultural economics; newly-developed regions, remote from the world's markets, such as Australasia and Siberia, have, under improved transport facilities, been able to specialise more profitably in butter production than in any other branch of agriculture²; and the earlier developed or long settled-regions, nearer to the great centres of population in Europe and North America have been forced by the rising prices of land to adopt more intensive methods of farming, and dairying has been one of the readiest means of accomplishing this.³

The rise of margarine manufacture on a large scale, since the commencement of the twentieth century, has undoubtedly eased the pressure that would have arisen upon the world's supplies of butter. In the earlier stages the materials used for the manufacture of margarine were almost wholly of animal origin, animal fats and milk being the principal ingredients.⁴ In recent years,

¹ The standard of living was also maintained, and perhaps even raised somewhat on an average, by an increased consumption of poultry produce, tropical fruits, sugar, etc. See U.S. Dept. Agric., Bureau of Crop Estimates, Report 190, p. 134.

² As noted above, the cheapness and efficiency of butter transportation under cold storage by land and on the sea, has aided in this direction. It has been pointed out also (Part I., Chap. ix.) that the introduction of the cream separator, the establishment of butter factories, and the rapid recent improvements in milking machines have all assisted in making dairying a prominent industry in certain newer regions where wages are high and hand labour costly and difficult to obtain. In the older countries, where hand labour has been comparatively cheap, these mechanical developments have played a less important part.

³ It will be seen later (Chap. v., below) that the dairy cow is a highly efficient converter of fodder into human food; hence where conditions are favourable good dairy cows are a profitable means of utilising land. This fact has no doubt assisted the development of dairying in the newer countries also, but is more prominent in the older countries where land is scarce.

⁴ For detailed information concerning the manufacture of margarine and for recipes giving materials used, see "Die Margarine Fabrikation," by Th. Buddinger, Trier, 1913; and "Die Margarine," by H. van Voornveld, Trier, 1913; also a paper entitled "Modern Margarine Technology," published by the Society of Chemical Industry, Dec. 15th, 1917. Animal fats (oleo, lard etc.) are still used for certain higher grades of margarine, though excellent products were made in Germany before the war from coconut oil. The recipes given in the above publications include three different classes as regards the liquid constituent (a) with whole milk, (b) with skim-milk, (c) with water.

however, with the growing shortage and rising prices of animal fats, vegetable oils have come to be used more and more extensively as the basic materials,¹ and it is now possible to manufacture a good commercial grade of margarine without any materials of animal origin whatsoever.² Improvements in processes and in factory plant and hygiene have been so extensive in recent years that a great variety of fats and oils, formerly almost unknown or used exclusively for industrial purposes are now employed successfully in the manufacture of perfectly edible brands of margarine. Since the outbreak of the war the increase in the consumption of margarine in the United Kingdom has been so great that this class of products bids fair to claim an equal place with butter in the total quantities consumed.³ So far as margarine is manufactured from materials of animal origin such as oleo, lard, milk and cream, it simply results in the conversion into a more palatable and serviceable form products that would in any case be consumed as human food sooner or later for the most part⁴; and in these circumstances margarine production does very little towards relieving the pressure of consumption upon the world's resources in animal foodstuffs—it may even increase the pressure by promoting an increase in the general consumption of animal fats in that special manufactured form. Owing, however, to the recent extensive substitution of vegetable oils for animal fats, the bulk of the margarine now consumed in Europe represents products of the vegetable kingdom converted directly into human food, without the costly intervention of animals, necessary for butter production.⁵

The production of butter throughout any region, and, indeed, throughout the agricultural world, is subject to competition from two main sources; first, from all other forms of agriculture affecting the dairy industry; and second, within the dairy industry,

¹ See U.S. Daily Commerce Report Oct. 25th 1912 in which the high per capita production and consumption of margarine in Denmark is noted and where it is stated that while in 1908 70% of the oils used were of animal origin and 30% per cent vegetable, by 1912 these figures were reversed.

² The following list of vegetable oils used for margarine manufacture has been given:—Coconut oil, palm-kernel oil, cotton-seed oil, ground-nut oil, soya bean oil, sesame oil, kopok, maize and wheat oil. Thorpe's Dictionary of Chemistry gives the following standard recipe for margarine: 85 parts oils (animal or vegetable) + 30 parts milk, yielding 100 parts margarine, 15 parts of water being eliminated in the process of manufacture.

³ The quantity of margarine manufactured in the United Kingdom early in 1918 has been estimated at 5,000 tons weekly, or at the rate of over 250,000 tons per annum. The output increased steadily during the year as shown by later figures. The total pre-war consumption of butter in the United Kingdom was about 325,000 tons.

⁴ Certain materials of animal origin sometimes used for margarine manufacture such as skim-milk and tallow, might not otherwise be consumed as human food, and in this direction there is thus an economy of resources.

⁵ The substitution of vegetable for animal oils in the manufacture of margarine constitutes a further relief to the agricultural resources in the temperate regions, owing to the fact that the former are mainly of tropical origin. See Part I. Chap. v.

from all other branches of that industry that utilise milk as the first-grade material. Each of these competing sources gains its strength from comparative demand on the consumption side, combined with comparative efficiency of food production, particularly when any limitation arises in the extent of the whole available agricultural resources.

In competition with other branches of agriculture the dairy industry, as a whole, in the principal countries has evidently had strength enough to hold its own. A study of live-stock statistics in different countries shows, that while the per capita ratio of all cattle has often declined in recent years, the per capita ratio of dairy cows has either been maintained or has declined to a smaller extent, and where the former ratio has risen the latter has generally risen still more.¹ Not only does this industry lend itself to intensive methods of farming, but with proper breeding and selection, the yield per cow has shown itself in various instances to be capable of great increase. In practice it is found that the dairy industry enables holders to gain a livelihood from smaller holdings than does ordinary crop farming.² It should be noted that the milk production per cow per annum has shown a tendency to increase in recent years more rapidly than the meat production per head of cattle enumerated.³ The conclusion is, therefore, that there has been a greater per capita gain or a smaller per capita decline in a number of countries in the consumption of dairy products than in the consumption of beef and veal.⁴

There is no doubt that the demand for dairy products has assisted in this victory of the dairy industry; the growing concentration of populations in large towns and the increase in the

¹ Striking examples occur in the case of France, the United States, Australia and New Zealand.

² The value of the dairy produce per acre is about four times as great reckoned in terms of human food as that of the beef produced when the land is devoted entirely to raising beef cattle. A crop rotation may or may not produce a greater quantity of human food, but the question of soil fertility tends, as shown above (Part I., Chap. viii.) to make animal industries inseparable from crop production in the long run. Concerning the unfavourable effects of specialisation in highly productive dairy cows upon meat production see p., below.

³ Two examples will suffice to show the tendency towards increased milk yields; in Denmark the average yield increased from 462 gallons in 1896 to about 630 gallons in 1911; estimated in Ontario, Canada, from 280 gallons in 1900 to 410 gallons in 1913. Where statistics are available, as in the United States, Germany and the United Kingdom, there does not appear to have been a decided tendency for the proportion of slaughterings to cattle enumerations to increase in recent years (see tables, U.S. Dept. Agric. Bureau of Crop Estimates, Report 109, pp. 124, 125). This may be largely explained by the greater proportions of dairy cows at the later date, since dairy cows reach the age of 5 to 7 years, or even more, before slaughtering, as compared with $1\frac{1}{2}$ to $2\frac{1}{2}$ years for beef cattle.

⁴ This perhaps does not apply to the world-market, but rather to individual countries. In temperate South America there has been an enormously greater increase in meat production than in butter production, which has indeed actually declined in recent years.

numbers of those engaged in sedentary occupations has increased the effective demand for the lighter forms of animal foodstuffs such as those furnished by that industry.

The competition which butter production has to meet [from other forms of production within the dairy industry has been serious, and threatens to be more so in the future, so long as a shortage is felt in animal foodstuffs. This competition is greatest from cheese production, but it arises also from the demand for milk for consumption as such, for the manufacture of dried and condensed milk, for the feeding of calves to be raised as prime beef-cattle, and to a limited extent also from the demand for milk for the manufacture of margarine.

A study of the facts show that the conversion of milk into butter is not the most economical means of utilising its food value for human consumption, unless the skim-milk is also consumed as human food.¹ The latter is usually used as a valuable part ration for pigs and calves, but there is a loss of food values in this process as compared with the other means of utilising whole milk, namely, the manufacture of cheese, and still more for direct consumption in households as such.²

It appears, therefore, that unless the production of milk expands greatly in the future, the manufacture of butter may become confined to those regions in which there is a great surplus of milk, and which are at the same time distant from centres of large population. Even in these regions the competition from cheese manufacture will be seriously felt,³ and to a smaller extent from dried milk manufacture. The growing shortage of meat supplies causes an increased demand for cheese as a substitute concentrated food-

¹ Unfortunately the mixed skim-milk by-product, obtained by means of the cream-separator, is suitable only for stock consumption, and as butter production is almost everywhere becoming dependent upon the separator for cheapness and efficiency, the disappearance of skim-milk from human consumption becomes more evident. The fact that butter cannot be produced with sufficient cheapness and efficiency by the hand-skimming method, yielding skim-milk suitable for human consumption, may result in a further weakening of the butter-making industry against cheese manufacture.

² Cow's milk contains, on an average, about 3.6% of fat, about 4.2% of milk sugar, about 4.5% of albumen and casein and about 0.7% of ash, or about 13% of solids in all. In butter manufacture the fat only is directly used as human food (unless the skim-milk is so available); in cheese manufacture the fat and the casein, while all the available solids are so utilised when the fresh milk is converted into dried or condensed milk, or, of course, when it is consumed as whole milk.

³ This is already the case in New Zealand, where the dairy industry was devoted in its early stages almost exclusively to the production of butter. Recently, however, cheese factories have rapidly increased and threaten in some cases to drive out the butter factories. The exports of cheese from New Zealand are as follows:—In 1906, 131,000 cwts.; in 1910, 452,000 cwts.; in 1913, 612,000 cwts.; and in 1916 about 1 million cwts. The exports of butter averaged 313,500 cwts. in the years 1904–6, and rose to an average of only 317,600 cwts. in the years 1908–12,

stuff.¹ Improvements in cheese manufacture with the establishment of specialised factories, the standardisation and grading of the products of these factories, and the increase in the varieties of market cheeses are factors that may assist in raising the popularity of cheese of different kinds as a substitute for meat.² It is possible that in the near future butter will be regarded much more in the nature of a luxury than has hitherto been the case, and that the customary edible fat for large masses of the industrial population in the various countries of Europe will be rather some form of margarine, manufactured more or less directly from vegetable products.

The high food value of whole milk appears to have been overlooked in the past.³ It is likely that for some time in the future the need will be felt for economising foodstuffs and for utilising the available supplies in the most complete way ; and one obvious method of doing this is to increase the consumption of whole milk as such, and to reduce correspondingly the consumption of extracts from milk, such as butter and cream.

In recent years there has been a great increase in the manufacture of condensed, and especially of dried milk. The latter appeared on the market only quite recently, as the inventions in machinery and processes necessary for the large-scale production of this article have not long been made. Dried milk, or milk powder, has one great advantage over condensed milk, namely, its greater portability. Apart from their value as useful substitutes for fresh milk for nursery consumption, the dried and condensed forms of milk are naturally of great service in mining centres and similar places, where it is either impossible to keep cows, or where the cost of keeping them or of bringing fresh milk from a distance is prohibitive. The consumption of these portable forms of milk has increased enormously in recent years, not only in pioneer settlements, but also in large and small towns throughout Western

¹ Conversely in the decade 1895-1906 it was noted that the per capita cheese consumption of the United Kingdom declined, consequent upon increased supplies of cheap imported meat.

² The high food value of full-milk cheese as compared with meat is not yet generally recognised. One lb. of cheese is said to be equal in food value to 2 lbs. of fresh beef and to 3 lbs. of fish.—U.S. Dept. Agric., Circ. 166. At ordinary market prices, therefore, cheese is a much cheaper food than meat or fish, and according to the authority above quoted, it is as completely digested as any other form of food experimented with.

³ In the United Kingdom in 1907-8 the total consumption of milk as such has been estimated at 1010 million gallons, or 23 gallons per capita, which amounts to about $\frac{1}{2}$ pint per day (Cd. 8123), p. 49.

The present small average consumption of milk in the United Kingdom and in some other countries with large urban populations, seems to be due partly to prejudice and ignorance, partly to the clumsy and costly system of distribution in use, and perhaps also in some countries to suspicions, not altogether unfounded, as to the cleanliness of the milk as delivered. Where these conditions do not appear as in Copenhagen, the per capita consumption of milk is higher.

Europe and North America.¹ where they have been largely consumed by the poorer classes among urban dwellers.²

With regard to the quantities of milk that are more or less completely lost to human consumption, by allowing calves to run with their mothers, little information is obtainable. Both in Great Britain and the United States a number of calves destined for beef production are reared during their early months in this way. The practice seems to be due to the fact that this proves to be one of the most effective and economical methods of producing prime beef of the kind known as baby beef. It is probable that this practice will continue with modifications so long as an effective demand exists for the prime beef, but it is hardly likely, however, to extend very much, owing to the keen demand and the high prices that will probably rule for milk for other purposes. To say that it is uneconomical or wasteful is only to say that the production of large quantities of prime beef in densely peopled regions is a wasteful way of utilising agricultural resources.

The conclusions reached at this point concerning the relations between the production and the consumption of dairy produce may now be summarised. It appears that under suitable conditions of soil and climate dairying can be made more profitable than the other leading branches of agriculture ; that owing to economies of production the consumption of dairy products tends to gain on that of meat ; that the utilisation of milk for butter production is perhaps the least economical way of consuming marketable milk, except in limited quantities and in remote areas ; that the manufacture and consumption of butter substitutes from vegetable oils is making great progress ; and that the more complete methods of utilising the food values in milk are gaining ground at the expense of butter production, and are likely to do so further in the future.

(c) POULTRY AND EGGS.

There has been a distinct tendency in recent times for the consumption both of poultry and eggs to increase among meat-consumers, owing partly to smaller per capita quantities of meat supplies and partly also to the growing preference for lighter forms of concentrated foods among town-dwellers.³ This latter factor

¹ The quantities of condensed and dried milk imported into the United Kingdom in 1913 totalled approximately 1·3 cwt., valued at £24. In addition there was a considerable quantity produced at home. In the United States in 1909 there were 300 factories for the manufacture of condensed milk, and ten for the manufacture of dried milk in 1911. An American authority states that dried milk "is likely to become a household article." See U.S. Year-book of Agriculture, 1912, article by Levi Wells on Condensed and Dried Milk, pp. 335-344.

² Dried milk has hitherto been used in the United Kingdom and North America largely by confectionery manufacturers and bakers for the making of confectionery, biscuits and small goods.

³ Consumption has increased through the greater regularisation of supplies throughout the year (particularly of eggs) due to the development of cold storage and other methods of preservation, and to improvements in the breeds of poultry leading to a longer productive season.

applies particularly to eggs, which in this respect resemble dairy products.

In the United States, for example, the consumption of eggs per capita increased noticeably in the period 1880-1910¹; and in the United Kingdom between 1900 and 1913 the imports of eggs increased at a greater rate than the population, while it is known that the home production increased considerably at the same time.²

From the present point of view table poultry and eggs stand in different classes. The former are more or less a luxury, within the reach of the wealthier people only, among town-dwellers; and though more generally consumed in the country districts, the birds so consumed are more the inferior grades that do not find a ready market in the towns. These statements are probably less true for North America, where poultry are more numerous in proportion to the population than in Western Europe. Nevertheless it remains on the whole true that poultry nowhere except in very special districts, form a considerable item in the diet of the meat-consuming populations of the world.

Eggs are much more widely consumed than poultry, and in times of plenty and low prices may reach even the poorer classes among industrial workers. In the country districts of almost all grain-growing regions, and throughout the more settled parts of North America and the Southern Hemisphere, eggs are freely consumed by all classes from the richest to the poorest. In Russia and parts of China also, where eggs are often very abundant and cheap, they are apparently consumed in considerable quantities by the poorer peasant population, and serve to some extent as a substitute for meat.

The food value of eggs in proportion to weight and to the normal prices is not very high,³ though the available nutriment has the advantage of being easily and completely assimilated, if the quantities consumed are not excessive. The popularity of eggs as a food-stuff is due to various special causes; their keeping qualities are

¹ The egg production of the United States has been estimated as follows (U.S. Dept. Agric. Bureau of Statistics, *Bulletin* 24) :—

1880	456.9 million doz.	9.1 per cap. (doz.)
1890	819.7 " "	13.1 " "
1900	1293.6 " "	17.0 " "
1909	1591.3 " "	17.6 " "

Exports have been trifling, especially in recent years, so that consumption may be taken as equivalent to production. See also Bureau Statistics, *Bulletin*, 55 p. 84: "It can hardly be questioned that the consumption of poultry and eggs has increased in a large degree in the last quarter century or so....."

² See Part III., Ch. iii., p. 301, Note 4.

³ The energy value of eggs per kilo has been given at 1,353 calories as compared with 2,687 calories for that of British home-killed beef. The latter however, has a higher proportion of protein, so that eggs contain about half the nourishing value of good beef pound for pound. The above figures are those of Prof. Thompson (Cd. 8421), p. 8. Atwater's figures show a somewhat higher calories value for eggs compared with beef. (Highest beef value = 1,120 calories per lb., hens' eggs 645 calories per lb.)

superior to those of meat ; they are available in convenient small quantities and are easily prepared for consumption ; and they are invaluable in manufacture of baker's goods and in ordinary household cooking wherever dishes are prepared from cereals or cereal products.¹

With regard to the quantities of poultry products raised (except where these enter into international trade), few countries attempt accurate statistical records. Poultry and eggs are still produced mainly as a by-product in ordinary farming operations, and great quantities are consumed on the farms or are sold in a small, miscellaneous way, without any records being kept. Yet the food value of the world's annual output of poultry and eggs is considerable, and the importance of this source of animal food supplies would become apparent if by any means the industry were suddenly swept away.² It is significant that the figures of the per capita consumption of meat for different countries show, in general, a progressive decline in proportion to the extent of poultry-rearing, though other factors also contribute to differences in these figures. The series Argentina (about 300) ; Australia (about 250) ; United Kingdom (120) ; Russia (50) ; China (very small), showing a descending rate of meat consumption in lbs. per capita, is known to be in ascending order of importance in poultry farming.³

In the absence of complete statistical information, it is difficult to present the use of poultry produce in human diet in a precise form, but some indication is afforded by the following facts. The total value of the poultry products consumed in Great Britain in 1902 was approximately £17 million, as estimated by a witness before a Royal Commission⁴ ; and after that year both the quantities and the values increased considerably till the year 1914.⁵ A comparison between the output of poultry products and of cheese in Canada brings out the striking importance of the former. The number of poultry in Canada in 1911 was about 32 millions, and the number of eggs produced in 1910 was estimated at 123·3 million dozen. If the average maturing period of each head of

¹ It is common kitchen knowledge that without eggs the variety and the palatability of the ordinary dietary suffers greatly.

² Although poultry and eggs form but a small proportion of the total food supply of the United Kingdom (see Cd. 8421, App. ix., I.A.), even in this country their food value was, prior to the war, nearly equivalent to that of the fish supplies, and there is reason to believe that in a number of other countries with greater rural population, these articles form a much higher proportion of the total food supplies of animal origin.

³ The United States, with a relatively high per capita meat consumption and an extensive poultry industry, is exceptional, owing to the unusually high standard of living there prevailing.

⁴ Royal Commission on Food Supplies in Time of War. Evidence of E. Brown, F.L.S., of the National Poultry Organisation Society (Cd. 2645). p. 295.

⁵ See Report of the Census of Production (Cd. 6277) p. 16. The total consumption of poultry, eggs, rabbits and game in the United Kingdom in 1911 had an estimated value of £25 millions.

poultry be taken as one year and the average weight as 3 lbs., the total weight of poultry meat would be about 96 million lbs. per annum; and if ten eggs weigh on an average 1 lb., the egg production would be equal to 148 million lbs. The total weight of poultry, meat and eggs would therefore be nearly 250 million lbs. of highly nutritious food. Now in 1911 the total weight of the cheese output of Canada was only 201.3 million lbs., or about $\frac{3}{4}$ of the weight of poultry products. Yet Canada in 1911 was the leading cheese-exporting country of the world. Concerning the production of poultry and eggs in the United States some striking facts are also available. In a recent year the total output was estimated at £150 million in value.¹ In 1907 the United States Secretary of Agriculture stated that the poultry products were worth more than the wheat.² The magnitude of poultry and egg production in China and in Russia has already been referred to in Chap. IV. of Part I., above.

A dense agricultural population is a favourable condition for poultry-rearing industries. The most important regions are Central and Eastern North America, Western and Eastern Europe, with Western Siberia and China. Outside these regions poultry production has not risen to any importance beyond supplying the limited local consumption. The temperate regions of the Southern Hemisphere, owing probably to the great abundance of meat, have hitherto generally neglected this branch of farming. Tropical countries, generally speaking, are unfavourable to domestic breeds of poultry and the methods employed by the natives are generally primitive. In any case, as was noticed in the Introductory Chapter of Part I., the peoples of the tropical regions do not feel so keenly the need for animal foodstuffs in this or in other forms.

Europe probably has more poultry than any other single continent. In many parts of Europe the conditions are highly favourable; there is an abundance of cheap local or imported grain; the average size of the holdings is medium or small; and there is also plenty of cheap peasant labour, especially that of women, to give the necessary care and attention. On many farms poultry with eggs supply the most important part of the animal foodstuffs consumed by the occupiers and their families, especially in the poorer parts from Central to Eastern Europe. Relatively to the population poultry raising has declined in Great Britain and Germany owing to the gathering of huge masses of population in towns where the industry is nearly impossible, and to the withdrawal from the country districts of large quantities of cheap labour formerly available for the detailed work required by this industry.

With the growth of co-operation and the spread of technical

¹ U.S. Dept. Agric., Animal Industry Report, 1911, p. 247.

² Cf. A. P. Brigham, *Commercial Geography*, 1911, p. 148: "Poultry produce is one of the four or five most important sources of agricultural wealth in the United States. . . . Poultry and eggs formed in 1899 one-sixth of all the products of animal origin."

knowledge, a change has lately arisen in the poultry industry, especially in Western Europe. Two great markets have appeared that seem able to absorb the whole of the surplus from the rest of the world; and since the transport costs for eggs are high, the tendency has been to aim at quality. Poultry-raising and egg-production are now conducted on intensive lines for the export trade in various countries of the elaborating-commercial type, notably in Denmark, Holland, Northern France and Ireland. In the most advanced of these countries the organisation of the industry under co-operative methods has become very high and the amount of technical, scientific and business knowledge accumulated concerning the industry immense. In Eastern Europe, in Hungary, Galicia and Russia, the industry seems still to be carried on under the old, haphazard methods, though Russia and Austria-Hungary easily led, up to 1914, in the world's egg and poultry export trade. Among Mediterranean countries Italy is the only important exporter, the products coming chiefly from the Northern Plain and travelling overland by rail to Germany and England.¹

In North America, where cereals are abundant, poultry-raising is, as has been noted, already a great industry. With the spread of more systematic and intensive methods among American and Canadian farmers, it is probable that the industry will make further great advances in the future in response to the demands of a growing population whose per capita consumption of meat tends to fall distinctly.² In view of this increasing demand and of the fact that labour is costly, it is doubtful whether there will be any marked increase in the present relatively small exports of poultry and eggs from the North American Continent.

The demand for eggs is highly elastic. Wherever meat is fairly plentiful, eggs in more than certain limited quantities become something of a luxury article in the dietary, whatever their cost. It is true that eggs are almost a necessity for young children and others such as invalids, but the quantities so consumed are small in proportion to the total. It follows, therefore, that consumers in general are willing to pay up to a certain price for eggs, but that beyond that price they prefer to do without them, or at least to reduce their consumption to the smallest limits. This limiting price has a definite relation, first to the general purchasing power, and second, to the comparative prices of other foodstuffs capable of providing the same elements of nourishment in a concentrated form, especially, therefore, of meats, fats and fish.³

¹ See U.S. Dept. Agric., Bureau of Animal Industry, *Bulletin* 65, for fairly complete, though not now very recent information concerning the Poultry and Egg Industry in the leading European countries.

² "The development of the (poultry) industry to an incredibly larger extent than it is at present, is among easy possibilities."—J. Russell Smith, *Industry and Commerce*, p. 73.

³ The ordinary consumer in making his choice of purchases of different foodstuffs is guided much more by taste than by any exact conception of the comparative food values of the articles available. Taste, however, serves

The demand for eggs being elastic, the quantities consumed depend upon conditions that affect supplies and prices. Now both the production and the transportation of eggs present certain peculiarities. The cheap and abundant production of eggs depends upon cheap and abundant supplies of cereals, especially of maize and barley, just as the cheap and abundant production of meat depends upon the existence of cheap and extensive pasture lands. We have seen that a certain moderate amount of poultry and egg production is incidental to mixed farming even in densely-peopled agricultural countries, since farmyard poultry in limited numbers consume very little in the way of marketable feedstuffs.¹ It appears therefore that a small local demand might be supplied at comparatively low prices, since the cost of production under such conditions would be nominal only.² It is quite otherwise, however, when poultry are kept in large numbers to meet the requirements of an extensive market, because they then consume cereals and other feedstuffs which have either to be purchased, or if grown on the farm, could be marketed or utilised in other ways.

It is owing to the fact that poultry, in order to be profitable, have to be fed largely upon cereal feedstuffs, that the most extensive poultry rearing and egg-producing industries have settled down upon the great cereal-producing regions of the world, especially those where barley and maize are prominent crops.³ The alternative to such localisation consists in the transportation of cereal products for poultry feedstuffs in bulk, to supplement the locally grown supplies of such feedstuffs in countries of denser population and more intensive methods of farm management. This is economically possible only in a few regions that have already access to the sea, good inland system of distribution, and a skilled agricultural population. Except under favourable geographical conditions, the transportation charges on these somewhat bulky goods are apt to be heavy in proportion to their farm value. If such imported feedstuffs form the greater part of those fed to the poultry flocks in any producing areas, it is probable that double transport charges have to be met, namely, first, those on the feedstuffs brought to the poultry farms from a distance; and second, those on the eggs from the farms to the urban centres of consumption. A further disadvantage that such a poultry industry depending as a rough, though sometimes quite unreliable, guide as to the comparative food values that a given sum of money will purchase. The craving for variety causes departures from the most economical expenditure of each individual's purchasing power available for foodstuffs, and in the case of eggs the margin between the price paid and the price of equivalent nourishment in terms of other foodstuffs may be considerable.

¹ The parallel facts concerning meat production, prices and consumption are discussed in Chap. v., below.

² Concerning nominal costs of production of poultry products, see U.S. Dept. Agric., *Farmer's Bulletin*, 560, p. 25.

³ Poultry-rearing is also found as a subsidiary industry to the production of butter, skim-milk and butter-milk being useful supplementary rations for poultry. The ideal conditions for poultry are found in a cereal region, where there is also some dairying, provided the human factor is not wanting.

upon imported feedstuffs has to face, arises from the fact that in practice the economies of large-scale production cannot easily be realised, since experience shows that large scale specialised poultry farms are apt to be commercially unsuccessful.¹ The chief advantages that such a poultry industry possesses seem to be due first, to the existence of dairying, and second, to the superior technical knowledge of poultry keepers, and the better breeds of poultry generally found in the more advanced countries of denser population.

With the growth of large industrial populations concentrated in relatively small areas, the practice has arisen of supplying eggs direct from the cereal-producing regions, especially from Austria-Hungary, Russia, and Siberia ;² the importing countries have been mainly Great Britain and Germany. This method has the advantage of involving but one set of transportation charges ; but these are apt to be heavy owing to the necessity for cold storage facilities, not only while the eggs are in transit, but still more at the collecting centres while awaiting despatch. In the case of Russia (the most considerable of all egg-exporting countries), such facilities have hitherto been inadequate, but recent progress shows that they may be sufficiently provided in the future, to the great advantage of the quality of the goods on delivery, and of the stability of the trade. The regions of surplus cereal production have great natural advantages for the production of poultry and eggs, and these advantages are likely to be utilised much more fully in the future, when, both in the Old World and the New, proper systems of collection and grading are established, suitable transport and storage facilities provided, and the requisite technical knowledge concerning the breeding and care of poultry becomes more widespread among farmers and peasants in the specialising areas.³

The above digressions into the field of production have been made partly in order to complete the whole subject, and partly in view of the proposition above made, that the consumption of eggs, present and future, depends upon the quantity of supplies available at a certain price relative to general purchasing power and to the price of other animal foodstuffs. On the whole, in the more favoured regions, given proper care and attention, poultry are economical converters of feedstuffs, and the cost of production of eggs is relatively low ; but much depends also upon the provision of proper trade facilities.

¹ H. Levy, *Large and Small Holdings*.—The chief causes seem to be the frequency of destructive diseases under the somewhat artificial conditions of rearing and to the lack of close personal attention on the part of hired workers.

² Some years before 1914 the Russian peasants were finding it more profitable to feed their grain to poultry than to sell it for export—Brit. Cons. Report, Moscow, 1909 (Cd. 4962—143), p. 8.

³ The fowl ranks fairly high as a converter of feedstuffs into foodstuffs. The quantity in dry weight of the former required by it to produce 1 lb. dry weight of the latter (eggs and flesh) being 14 lbs. It is exceeded only by the dairy cow and the pig, which use only 12 lbs.—Wood, *National Food Supply*, 1917, pp. 33, 34.

FISHERIES AND THE CONSUMPTION OF FISH IN RELATION TO THE CONSUMPTION OF ANIMAL FOODSTUFFS.

Although fish are excluded from the category of animal foodstuffs—the importance of fish supplies as a substitute for meat and other animal foodstuffs is so great as to make some discussion of them necessary in this inquiry.

Reference has been made incidentally above to the manner in which fish are utilised so as to reduce the per capita meat consumption in Japan, Russia, the Scandinavian countries and the Mediterranean countries. Fish are also extensively consumed in the United Kingdom, Canada and the United States, in all of which countries the per capita meat consumption is relatively high, but the standard of living in them is also high and fish are there used rather as supplementary to meat than as a substitute for it.¹ Nevertheless, in these countries in the absence of fish, either the standard of living would suffer, or the per capita consumption of animal foodstuffs would rise.

All over the world, wherever there is an abundant and cheap supply of fish, the consumption of animal foodstuffs tends to be reduced.² Analyses show that the value of fish as a substitute for meat arises from their average high protein content,³ though some kinds are also rich in fat or oil. The produce of the world's fisheries may, therefore, be regarded as relieving to a considerable extent the pressure upon the world's animal industries.

With the rapid increase in the populations of cool temperate latitudes and the rise in the standard of living evident among them, the question arises as to how far the production of fish will keep

¹ Except in the large towns of the United Kingdom, where the cheapness of certain kinds of fish and the relatively low purchasing power of the poorer classes causes a normal substitution of fish for meat to some extent in the dietary of these classes.

² Conversely where the fish supplies are small, the per capita consumption of animal foodstuffs, particularly of meat, tends to be abnormally high. Examples occur in Argentina, Australia and New Zealand.

³ The following analyses are those given by Atwater. (U.S. Dept. Agric. *Bulletin* 28). Other analyses correspond closely.

	PROTEIN %	ASH %	FAT %	ENERGY VAL. PER LB. (CALORIES)
Cod (whole)	8.0	0.6	0.2	155
Flounder ..	5.6	0.5	0.3	115
Herring ..	10.9	0.9	3.9	370
Salmon	12.4	0.9	8.1	570
Beef (rump) ...	14.4	0.8	19.0	1070

For the purpose of comparison the figures for beef should be reduced by one-third to one-half, since the dressed weight of an ox is not much more than half its whole or live weight. Pound for pound a salmon contains nearly as much concentrated food material (protein and fat) as a steer.

pace with the consumption. The answer to this question has a very distant bearing upon the subject of animal food supplies in relation to consumption.

It is known that sea-fisheries, and still more fresh-water fisheries, show signs of exhaustion when modern methods of fishing are applied without restriction. Moreover, where, as in parts of Europe and North America, manufacturing centres, or even towns without manufactures, grow up on the river banks, river pollution often sets in, causing destruction to the fish in these streams. The general conclusion appears to be that, unless care is taken in the protection of fisheries, their yields commence sooner or later to diminish. The only exception to this rule is found in the deep-sea fisheries, where the field is naturally a very wide one in proportion to the extent of the fishing operations. Owing, however, to the greater difficulties and expense of fishing in deep waters and the limited range of varieties of fish obtained in them, the bulk of the world's supplies of sea-fish are caught in the shallower waters of the continental shelves.¹

The regulation of fisheries which is possible in inland waters and in the territorial waters round the coasts of the various countries, becomes almost possible without international agreement in the ordinary fishing grounds some distance from the land. The permanent yield of such fisheries for the world at large could no doubt be increased by the enforcement of proper restrictions upon fishing fleets, but so far little has been done in this direction; the result is that fish are becoming less plentiful in the more accessible waters round the North-Western European coasts, and fishing fleets have constantly to travel further from their ports in search of catches, though this might happen to some extent under the present extensive fishing operations, no matter how well regulated.

With a view to the preservation and extension of fresh-water fisheries the governments of most countries have established controlling authorities with apparently good results. Steps have been taken to regulate the methods of fishing, to prevent avoidable pollution of rivers and lakes, and, what is of great promise for the future, to establish hatcheries and other means of increasing the variety and quantity of the fish available for food from these sources. Large private societies in certain countries, notably in Germany, assisted by government subventions, are actively engaged in the work of increasing the supplies of fish in the streams and lakes. An American authority in this connection has described the inland fisheries of the United States as having passed through three stages; first, that of abundant natural supplies; second, that of comparative exhaustion through unrestricted fishing and improper care of fisheries; and third (the existing stage) of increasing supplies due to suitable regulation and artificial stocking.

¹ For a clear account of the sea-fisheries of North-Western Europe, and especially those drawn upon by the British Isles, see *Geog. Journal*, 1915, pp. 472-90.

A general review of the situation with regard to the future production of fish throughout the world leads to the conclusion that a great increase in the yields of the sea-fisheries within easy reach of the centres of dense population is problematic ¹; although a considerable increase is apparently possible in the production of the more distant fisheries, especially those of the Southern Hemisphere. Improvements in the methods of preserving fish and the cheapening of refrigerated transport may make certain quantities of these more distant supplies available where the demand is greatest. On the other hand, the high cost of labour prevailing in the lands adjoining some of these fisheries and the comparative absence of a local market for fish may cause development to be slow. For fresh-water fisheries the outlook is more promising, and considerable increase in production may be expected with the fuller stocking of the numberless streams and lakes of the North Temperate Zone.

¹ In the first few years after the close of the war, however, it is probable that the effective supplies of sea-fish can be greatly increased above those of pre-war times.

APPENDIX TO CHAPTER II.

Note on the cost of the dietary of a given population in terms of the agricultural resources required for, and the costs of production of, various kinds of foodstuffs.

The total per capita cost of the foodstuffs of any section of the world's population, other things being equal, depends upon the proportion in which the two great classes of foodstuffs, plant and animal, enter into the dietary, since this determines mainly the agricultural resources required per head. The cost of nourishment in terms of agricultural resources per capita for the dense Asiatic populations that live mainly or entirely upon produce of the plant kingdom is exceedingly low. While it is neither possible nor desirable for white peoples to reduce their dietary to the same standard, the study of this great difference between Asiatics and Whites throws light upon the economic principles underlying the consumption of foodstuffs in relation to production and costs. From one point of view the consumption of all but quite limited quantities of animal foodstuffs in any region within reach of the international markets represents a kind of luxury habit; and the consumption of certain animal foodstuffs such as prime beef is more so than that of others. This is so, because practically all kinds of finished animal foodstuffs necessitate, at least in part, a diversion of crop-producing resources from direct human consumption; it is much more costly to produce a unit of human food values in the form of meat, or even dairy produce. The feedstuffs required by food-producing animals for maintenance apart from production, which, on the average, represent over one-half of the total feedstuffs consumed,¹ are a loss that is never replaced. Thus, after a certain point, the greater the land area devoted to pastures and to feed-crops for such animals, the more expensive the dietary of the consuming population becomes under modern conditions of restricted agricultural resources.²

The question becomes more striking when the growth of population, by making the limitation of the resources in agricultural land to be more keenly felt, forces up the price of such land. On the consumption side, the problem for the near future for white populations in both the Old and the New World may be to discover, and to become accustomed to the consumption of, efficient substitutes directly from the plant kingdom for part of the present consumption of animal foodstuffs. In this way the demand upon the available agricultural resources would be reduced to some extent, and the tendency for all foodstuffs, including those of animal origin, to rise in price, would be checked. In practice such changes in consumption would scarcely take place except under the pressure of high prices for foodstuffs relative to purchasing power. As a temporary measure these changes might be

¹ U.S. Dept. of Agric., Bureau of Animal Industry, *Bulletin* 143, p. 8.

² See also p. 255 below.

effective in restraining the upward trend of land values, until production became sufficiently increased by the progress of intensification to allow of a free consumption of animal foodstuffs without causing pressure upon land resources.

It has been pointed out in the preceding pages that imports and exports of feedstuffs are equivalent in reality to imports and exports of meat and dairy produce. Now it should be noted that consignments of cereal feedstuffs represent potential consignments of wheat and other plant foodstuffs for human consumption directly. There remain, of course, considerable residue quantities of milling offals and of seed-cakes that can best be utilised as feedstuffs for food-producing animals; but these would suffice to produce only a fraction of the present supplies of animal foodstuffs without the produce, whether cereal feedstuffs, fodder crops, or pasture grasses, of much land that could be used for growing food-crops. The great quantities of cereals and other feed materials grown throughout the temperate parts of the world purposely for consumption by animals, constitute in some measure a drain upon agricultural resources.

In the course of this inquiry we shall consider how the tax upon agricultural resources may, if necessary, be relieved in some limited measure by changes in the consumption of white populations, whereby part of the animal foodstuffs now consumed may be replaced by plant foodstuffs and certain animal foodstuffs by others that are, as a rule, more economically produced. We shall see, as we proceed that the production of animal foodstuffs is no longer economical of resources when it ceases to be incidental to the main business of raising food crops; so long as it uses land or agricultural produce (in crop rotations or otherwise) that would else remain unutilised, all is well; but when it competes actively with food crops for the use of agricultural resources, it becomes theoretically uneconomical from the point of view of human nourishment. The same principle applies within the group of animal foodstuffs themselves, as, for example, to the production of meat as incidental to that of dairy products. In order to obtain the maximum food values from given agricultural resources, it is obvious that the consumption of animal foodstuffs should be adjusted so that it absorbs all that is produced in this incidental way and nothing more. This may for convenience be called the principle of incidental production in relation to consumption.

All this may be somewhat negative in that it appears to cut across the normal working of supply and demand, but it serves as a guide in what may be termed a "policy of nutrition," a thing not altogether unknown in European countries during the present war, and of possible wider application in the future.

There exists the positive problem, namely, that of increasing the productive agricultural resources relative to the consuming populations. The main effective methods in this direction have been discussed in Part I., above, and a short reference to some special methods appears at the close of Chap. v. below.

CHAPTER III.

THE RELATION OF ANIMAL FOODSTUFFS TO OTHER ARTICLES OF DIET.

IN dealing with the questions arising in this chapter, it is convenient to consider at once the physiological requirements of the ordinary human being in the matter of nourishment. For the special purpose of this discussion, which is concerned more particularly with the food consumption of the active European, the standard adopted by the Royal Society Committee appointed to investigate the food supply of the United Kingdom may be taken as sufficiently representative. This standard prescribes as the minimum requirement per day for an average workman doing an average day's work, 100 grammes of protein, 100 grammes of fat and 500 grammes of carbohydrate equivalent to 3,400 calories approximately.¹

The economics of human nourishment are especially concerned with the manner in which the minimum requirements in the various factors of nutrition can be most economically and efficiently supplied from the existing available agricultural resources. If it is held that the latter are limited throughout the world in proportion

¹ See Report of Committee (Cd. 8421), 1917, p. 3. The Committee points out that for the purpose of reducing the whole population to "men," 100 persons of the mixed population in the United Kingdom are equivalent to 77 men. Obviously in other countries, where the sex-distribution is more equal and the proportion of actively employed men higher than in the United Kingdom, the conversion formula must be correspondingly raised. Thus in North America and Australasia, 100 persons of mixed population would be equivalent to 80 or more "men" in this connection. The age constitution of the populations in different countries also affects the equivalent of the population to men-units in the consumption of foodstuffs (see Chap. iv., below).

Other nutrition standards differ somewhat from the above, those of Voit being as follows:—

For a man at hard work, 133 gm. protein, 95 gm. fat, 437 gm. carbohyd = 3270 calories.

For a man at moderate work, 109 gm. protein, 53 gm. fat, 485 gm. carbohyd. = 2,965 calories.

This standard has been criticised as being too liberal in protein. See Eltzbacher, "Die Deutsche Volksernährung und der Englische Aushungerungsplan" (p. 28), where 80 gm. of protein and the equivalent of 3,000 calories are taken as a sufficient daily ration for an ordinary man (p. 29).

A critical discussion of the methods of arriving at nutrition standards together with an account of some carefully collected statistics is given in *Nature*, Jan. 17th, 1918.

It may be that the standard of 100 grammes of protein is rather higher than the average man requires, and it certainly appears that some classes among the various white populations have habitually consumed more protein than is necessary for health and efficiency. This has a most important bearing upon the consumption of animal foodstuffs, since these are distinguished by a high average proportion of digestible protein.

to the populations to be fed, then it becomes necessary to review the customary dietary with the object of enquiring whether any alterations are possible in the proportion of the various foodstuffs consumed, that would result in economies of agricultural resources without at the same time impairing the proper nutrition of the populations considered. Under this head it is especially proper to note whether the requirements can still be supplied, when part of the present normal consumption of animal foodstuffs is replaced by plant foodstuffs. Considerable evidence exists which points to the conclusion that this is possible in certain populations and in the wealthier classes almost everywhere among white peoples.¹

When the requirements in the three outstanding constituents of the normal diet are separately examined, it is found that the carbohydrates are derived almost entirely from plant foodstuffs,² while under average European conditions a large part of the protein and of the fat is obtained from animal foodstuffs and from fish.

The question arises whether an appreciable part of the protein and fat requirements, obtained at present in the form of animal foodstuffs, cannot almost as well (without causing noticeable inconvenience or impairment of efficiency to consumers) be got from plant foodstuffs directly. In the countries of Europe in earlier times, as at the present day in many less advanced parts of the globe, the masses of the populations lived largely upon plant foodstuffs; but the standard of living for them was low, as it is in the uncivilised parts of the world at present. The populations of Europe and of the newly developed countries can have no desire to reduce their standards of living and efficiency to such a level. The problem at the present juncture is to effect a part substitution of plant for animal foodstuffs, while at the same time maintaining, or possibly even raising in some cases, the general standard of living.³ A simpler form of the same problem appears in the sub-

¹ The fact that the consumption of meat among the people of the United Kingdom has ranged from about 1 lb. per day among the wealthier classes to 1 lb. per week among the poorest, points to excessive consumption by the former in spite of under-consumption by the latter.

Compare also the following quotations from a Columbia University Research Paper entitled "Marketing Perishable Farm Products," 1916. "The indications are that we, as a nation, must depend less and less upon beef and pork as our main diet, and more and more upon vegetables, fruits and domestic fowls."—p. 28.

"If we, as a nation, are to have a cheap food supply in the future, it must come largely from the plant kingdom rather than from the animal."—p. 29.

² Meats of various kinds contain practically no carbohydrates which, however, are found in small proportion in milk and cheese, the respective percentages being 5% and 2-4%.

³ This is partly also a social problem arising from the wide difference in the purchasing-power of different groups in modern communities. Obviously a limited supply of concentrated, that is, animal foodstuffs, could be more efficiently used from the national point of view if the per capita distribution were more equal than it has been. It is doubtful, however, apart from war measures, whether much will be done in the direction of reducing such inequalities of distribution, and in considering minimum normal requirements an allowance must be made for excessive consumption by certain classes.

stitution, as far as possible, of animal foodstuffs, the production of which demands smaller agricultural resources per unit of food values, in the place of those the production of which requires greater.

It is by no means intended to argue at this point in favour of a strictly vegetarian diet for Europeans. General experience, on the contrary, points to the fact that a certain proportion of the more concentrated animal foodstuffs is desirable in the diet of the average European, under the existing conditions of life, and in view of the more or less limited range of plant foodstuffs available in easily assimilated forms. It appears, however, that the existing resources in the latter class of foodstuffs can be more fully utilised than at present, so as to reduce to some extent the dependence upon animal foodstuffs for the proper supplies of protein and fats.¹

The supplies of protein in the dietary of Europeans may be met independently of meat, to a certain extent by an increased consumption of whole-meal flour made from wheat and other grains, of higher percentage wheat flour, and of vegetable products and nuts rich in protein.² Some of the additional protein taken in these forms may not be capable of complete assimilation by sedentary people who have been accustomed to liberal supplies of meat ; and an unusual increase in the proportion of such foodstuffs is apt to cause digestive derangements. The rise in the standard of living that has taken place in the last half-century among average Europeans in the form of improvements in the variety and quality of the foodstuffs in the normal dietary, together with the great increase in the numbers engaged in sedentary occupations, appear to have produced constitutional changes which now make it impossible in practice for any but the lowest classes to live largely upon coarse foods. This appears in children as well as adults, so that with the generally existing methods of preparing plant foodstuffs, definite limits are set in the case of the average person, to the substitution of plant foodstuffs for animal, as a means of supplying the required protein.³

¹ It appears that meat stimulates the living cells to increased activity, and is, therefore, of value in the diet of brain-workers. The heat and muscular energy of the body are well supplied by carbohydrates, which are well assimilated by the manual worker, and are capable of supplying most of the energy expended in his work, though his efficiency is increased by the consumption of meat and other animal foodstuffs.—Prof. Leonard Hill, *Times*, Nov. 21st, 1917, article entitled "Scientific Rationing."

² Changes in these directions would of course reduce the quantities of milling offals and other concentrated feedstuffs available for food animals, but there would be a considerable net gain to human food supplies. For a clear statement of this point, see a brochure entitled "*Quelques Principes pour une Politique de Ravitaillement*," by Louis Lapique, Paris, 1916.

³ The coarser plant foodstuffs have the further disadvantage that they demand a greater amount of bodily energy for their digestion than do the ordinary animal foodstuffs. These extra supplies of energy can only be obtained by an increased consumption of food.

Among the poorer classes of Northern European populations wholemeal bread was formerly the principal article of food, meat being rarely consumed by them. This is the case at the present day among the labourers of Central and Eastern Europe. In other parts of the world at the present time, peas and beans, which are rich in protein, are used, together with vegetable oils, as a substitute for meat; this occurs particularly in Eastern Asia and Mediterranean Europe, where the agricultural resources are small in proportion to the population and where also the standard of living is generally low.

It may be premised that the meat-consuming populations of the world are unlikely to lower their standards of living in the near future, except in the event of a severe world-shortage of foodstuffs, which would probably be temporary only. It does not, therefore, appear that the solution of the difficulties arising from any moderate shortage will lie in the direction of an extensive substitution of coarser plant foodstuffs containing protein, in place of meat.¹ Something, however, may be done in this direction on a moderate scale, especially through improvements in the manufacture and preparation of plant foodstuffs rich in protein, so as to render them more digestible, palatable and varied in form.² Something may also be done by reducing the waste in consumption.³ Though these developments may be of great temporary value, the principle maintained throughout this enquiry is that the solution of the present and future shortage difficulties in the matter of meat (*i.e.*, protein)

¹ This is theoretically possible in the newer countries where the meat consumption per capita is high, and where the average person consumes more protein than is strictly necessary; but the economic organisation of the world is not such that each country is allotted a share of the different commodities according to population and requirements, but rather that the greatest share goes where there is the highest purchasing power. However, the recently instituted rationing systems in European countries seem to show that some populations can maintain health and efficiency, for a time at least, on a smaller per capita consumption of animal foodstuffs than has previously been the case, provided distribution is equal.

² Developments in this direction are likely to make great progress in the near future in those parts of the world populated by Europeans. A lead has been given by the United States where there have been large increases in the per capita consumption of foods other than meat during the last twenty-five years, especially of wheat, vegetables and fruits, eggs and poultry and sugar. (U.S. Dept. Agric., Bureau of Statistics, *Bulletin* 55, p. 83). The same authority goes on to state that when the pressure of expenditure comes, it is found that more protein and energy values can be obtained for the same cost in other forms such as sugar, rolled oats, wheat-flour, maize and potatoes. The centralisation of produce markets and of milling and other manufacturing processes connected with foodstuffs, the improvements in the plant and technical methods employed, all assist in making properly elaborated plant foodstuffs available in increasing quantities and variety. The result is a more complete utilisation of the resources of the vegetable kingdom directly as human food; the standard of living can be maintained with a somewhat smaller dependence upon animal foodstuffs.

³ See below, Chap. iv., pp. 246-9.

supplies lies rather in a change from the generally uneconomical and unscientific methods of production.¹

In the matter of fats, the second important element in the dietary mentioned above, the necessary supplies in the colder climates of both hemispheres have been derived entirely from animals in the form either of the fat from meat or of that from dairy produce. Vegetable oils, which have for centuries been so widely used in the Mediterranean countries and in some parts of Asia, have been consumed only in very small quantities in colder latitudes. This has been owing to geographical factors, such as the absence of oil-producing plants, the existence of extensive herds of fat-producing animals, and the accessibility to fishing grounds.

All cultivated cereals, however, and especially oats and maize, contain a certain percentage of fat² and any more extensive use of cereals as foodstuffs on the lines suggested above would result in an increase in the supplies of fat in human nourishment derived directly from the plant kingdom.³ The same is true to a very limited extent of garden vegetables.⁴

It has been already noted that margarine as now manufactured may consist mainly or entirely of oils derived directly from the plant kingdom. The development of this industry and the increasing consumption of margarine as a substitute for butter and lard, is to be regarded as the most effective means for diminishing the dependence of peoples in the cold temperate climates upon animal produce for their supplies of edible fats.

It is to be observed, moreover, that fats and carbohydrates are interchangeable to some extent in the dietary,⁵ and it is therefore possible that the present consumption of animal fats may, in the future, be reduced to a limited extent by an increased use of carbohydrates. As the latter are found almost exclusively in plant foodstuffs, any change in this direction would mean a corresponding decline in the consumption of that form of animal foodstuffs for which a liberal expenditure in feedstuffs is required. The average consumption of animal fats, at any rate in English-speaking countries, appears in recent years to have been considerably in excess of bodily requirements. Thus according to the Report of the Committee on the Food Supply of the United Kingdom, above

¹ This question is discussed at length in Part I., Chap. xii. See also Chap. v. below.

² The following figures of fat content have been taken from the estimates of Prof. W. H. Thompson in the Report of the Committee of the Royal Society on the Food Supply of the United Kingdom :—Wheat flour, 1% ; oatmeal, 7.2% ; barley meal and flour, 2.2% ; maize meal, 4.2% ; rice, 0.3%.

³ That is, unless the special processes of manufacture result in the removal of part of the fat contents.

⁴ The fat content of vegetables in ordinary consumption is very small. In dried peas and beans it is 1.3%, but in other vegetables it does not exceed one half of 1 per cent.

⁵ But to a limited extent only. Investigations show that meat can be more completely dispensed with than fats in the dietary without injury.

quoted, the excess consumption of fat in the United Kingdom in the period 1909-13 was upwards of 30% above the Committee's standard, while the excess for protein and carbohydrates were but 11% to 14% and 10% to 14% respectively. Moreover, the standard of 100 grammes of fat per man per day is above the standard adopted by other, especially continental, authorities. It would appear that the per capita consumption of animal fats among most meat-eating populations would be materially reduced without any injury to the efficiency standard. In connection with this question of the substitution of carbohydrates for edible fats in the European dietary, it is observed that the per capita consumption of sugar among white populations, and especially among the English-speaking sections, has increased notably in recent years, and may do so still further in the future. Since sugar consists entirely of highly digestible carbohydrates, it is quite possible that this plant foodstuff may be used to replace in some measure the animal fats now consumed in such enormous quantities.¹ On the whole, the conclusion is that less attention may well be devoted in the future to the production of highly fattened stock for slaughtering. It is well known that meat-animals require the largest quantities of the concentrated feedstuffs (mainly cereals) in the fattening stage. Apart from the general improvement in the flavour of the meat, which such "finishing" is held to produce, the process must be regarded as wasteful. The extra fat so produced is obtained at considerable cost to agricultural resources in the form of concentrated feedstuffs, is apparently consumed in excessive quantities by the average European, and is frequently even completely wasted in the household.

The general question of future fish supplies has been discussed in the preceding chapter, and reference may be made again at this point to the importance of fish as a means of providing protein and fat in human nourishment. The influence of fish supplies, especially in cold temperate latitudes, upon the consumption of animal foodstuffs such as meat and animal fats, cannot be overestimated. In theory, as well as in practice, the per capita consumption of fish and animal foodstuffs together forms a composite unit that tends to remain constant or to alter only with changes in the material circumstances of whole populations.² It follows that any increase in the output of the world's fisheries, any improvements in the methods of transporting, storing and preserving of fish, or in the organisation of fish markets, will tend to diminish the general requirements in the matter of animal foodstuffs and to

¹ With reference to the further economy of temperate agricultural resources by the substitution of cane for beet sugar, see Part I., Chap. xi., pp. 166, 167.

² It has been suggested that the meat shortage, which will probably be acute throughout the world at the close of the present war, will be obviated to some extent by an enormous expansion in fish supplies. See below, p. 317

lead to a more economical utilisation of agricultural resources in the service of human nourishment.¹

The bearing of comparative prices as affecting the consumption of different kinds of foodstuffs, calls for notice. The bulk of the consumers in any of the meat-eating regions now consists of workers and their dependents whose means for the purchase of foodstuffs are in general limited, and who therefore tend to consume by preference such foodstuffs as are cheapest and at the same time furnish the necessary food values. The demand created by the wealthy for luxury foodstuffs that are uneconomically produced works in the opposite direction²; and habits and prejudices among all classes may have the same effects. On the whole, and in the long run, however, the law of substitution in consumption comes into operation, so that finally the relative quantities of the different kinds of foodstuffs capable of substitution for one another in keeping with physiological requirements, depend roughly upon the respective costs of production. This principle operates most completely when the general purchasing power of consumers and the agricultural resources available for the supply of these foodstuffs are both limited.

Now it is pointed out elsewhere that of the different kinds of meat, beef and mutton can be produced cheaply only where there are large areas of cheap pasture land, or where fodders and feedstuffs can be produced or purchased in large quantities and at low prices; while the cheap production of pork depends upon abundant supplies of low-priced concentrated feedstuffs. When agricultural resources become limited, the costs of production of these main classes of meat rise owing to the increased value of land; under these conditions that of mutton rises most rapidly and that of pork perhaps least. The cost of production of dairy products under the same conditions is generally lower per unit of food values wherever the climatic conditions are favourable, owing to the greater return in food units per acre. Again cereals and other food crops form a still cheaper kind of human nourishment, because of the still larger return per acre under average conditions, and because cereals are produced in many regions that are unsuitable for, or for other reasons are lacking in, animal industries. Similarly also in many regions of dense population, certain kinds of fish of high nutritive value reach consumers at prices which, when food values are taken into consideration, are low compared with those of meat. In other words, under certain conditions fish as a foodstuff can be produced more cheaply than meat.

¹ It appears from a comparison of the prices of fish as landed with the retail market prices, that in the United Kingdom at all events, the costs of distribution are inordinately high, and serve, therefore, to hinder the substitution of fish for meat, which ought, under the existing conditions, to be encouraged rather than hindered.

² See Chap. iv., below, p. 244 and 247-8.

Pressure of population upon agricultural resources tends therefore in general to cause a downward substitution of foodstuffs, capable of yielding the required nourishment, according to the scale of their relative costs. Meat, which is the most costly of the great classes of nutritive foodstuffs¹ to produce in terms of agricultural resources, may tend to disappear, especially among the poorer classes, in favour of dairy products or fish, and these in their turn may tend to disappear in favour of cereals and other plant foodstuffs.²

Whether this process of substitution is desirable from the economic point of view depends on the level of the standard of subsistence which, it will be admitted, should be maintained at a point that involves neither mal-nutrition nor under-nourishment, since both of these impair health and efficiency. In certain sections of the white population, which consume normally a high proportion of animal foodstuffs, this process of substitution might be carried to a certain point without any injury; among the poorer populations of Europe there is little or no room for its operation—their present need is for upward rather than for downward substitution. However, among white populations in general there is little doubt that economies in nutrition could be effected without injury to health and efficiency by substituting certain kinds of meat for others and by substituting fish more extensively for meats.

¹ That is, as distinguished from stimulants and luxuries.

² Various studies in nutrition point to the high comparative money cost of meat as a source of nourishment. Thus in the United States it has been found that meat and poultry, while supplying about one-sixth of the total nourishment, account for more than one-third of the total expenditure on food in the average household.—U.S. Dept. Agric., *Farmers' Bulletin*, 391, and Bureau of Statistics, *Bulletin* 55. Again in a standard dietary on a liberal scale for middle-class adults in a large convalescent home near London in 1913 the cost of the various items in the weekly food budget shows that animal foodstuffs (excluding, of course, fish) accounted for about 68% of the cost, but only about 42% of the calorie value.—*Journal Board Agric.*, March, 1917.

CHAPTER IV.

ECONOMIC FACTORS THAT INFLUENCE THE RATE OF CONSUMPTION OF ANIMAL FOODSTUFFS.

IT is convenient now to examine in further detail the economic factors that influence the rate of consumption of animal food-stuffs as a whole. Some of these factors are of world-wide operation, and others are confined to limited areas. Those selected for special consideration in this chapter are : first, changes in the rates of wages and in the general purchasing power ; second, the migration of consuming populations with reference to latitude ; third, the influence of habit and custom ; fourth, the element of waste ; fifth, the principle of substitution ; and sixth, changes in the age-constitution of certain consuming populations. We shall discuss these factors in the above order.

It has been observed as an economic fact that increase in population in the more advanced countries is bound up with those industries that yield an increasing return. Now, generally speaking, agriculture is not at present one of these industries ; in recent times, in all the more civilised countries the manufacturing and trading centres have shown the greatest increase in population while the population in the rural districts has been almost stationary. Indeed, in some of these countries the towns have succeeded in attracting to themselves not only the whole of the general increase in population, but have in addition withdrawn part of the rural population, so that the increase in urban population has been greater absolutely than that of the whole country.

The progress of industrialism with the consequent growth of urban centres has in recent times generally enabled the increasing population to live in greater comparative comfort. Purchasing power has, as a rule, risen more rapidly in industrial countries than in those that have remained purely agricultural,¹ and this is only another way of saying that technical progress, as applied to industry, has caused an increased production of economic values per worker as compared with the production of the same by the average agricultural worker who has not been assisted to the same extent by technical progress. Population does tend, nevertheless, to increase rapidly in some countries where the great mass of the population is rural. Examples are found in the more backward among European countries, such as Russia, and Asiatic countries such as India and China. However, in such cases population tends to overtake agricultural production and the standard of subsistence

¹ The newer countries of great agricultural resources form, of course, an exception to this statement.

is accordingly low, and has little chance of rising unless considerable technical progress is made in agricultural methods, or the rate of increase in the population is checked.¹

What is of importance to observe here is that the progress of industrialism in recent times and at the present day, in any particular area causes increased general prosperity, and thus leads to a greater purchasing-power for foodstuffs. The direct result of this is that animal foodstuffs are more freely consumed by the average unit of the population. The increased prosperity of the towns, appearing partly in the form of higher wages in industrial occupations reacts upon the rate of wages paid to agricultural workers in the same economic region, causing these wages to rise in sympathy. Thus the progress of industrialism, so marked in a number of countries at the present time, tends in general to cause an increase in the purchasing power of workers all round, and, as a consequence, to increase their per capita consumption of animal foodstuffs.² Among European countries Germany and Great Britain are instances in point; in both of them the consumption of meat (and of other animal foodstuffs apparently as well) rose continuously during the second half of the 19th century and the first decade of the 20th century.³

It is also to be observed that the urban industrial worker, whose work tends to be both monotonous and sedentary, requires a more varied and richer diet to maintain health and efficiency than the agricultural worker does. The latter lives in the main an open-air life with plenty of movement, and is able to subsist on coarser food; having a stronger digestion, he can manage with a smaller proportion of the foodstuffs of high protein or fat ratio in his diet. The average agricultural worker also, in Europe at any rate, has

¹ The introduction of modern methods and machinery into agriculture in countries of dense rural population living at a low standard, presents peculiar difficulties owing, in the first place, to a low standard of intelligence and widespread ignorance; in the second place, to the very limited resources of the peasants; and in the third, to the fact that the land is often divided into uneconomically small holdings suited only to hand labour. The best remedy in such conditions seems to be the introduction of agricultural co-operation.

² The working of this process causes an interesting set of problems to arise. The increased demand for animal foodstuffs on the part of town populations has caused pressure upon supplies, the production of which is handicapped by the scarcity of labour due to the attraction of the more able-bodied to the towns and to the sympathetic rise in agricultural wages. Price-cutting competition in animal foodstuffs has already under these conditions worked itself out in the world-market, and prices have commenced to rise. If the urban consumer is not to suffer, the remedies that suggest themselves are first and foremost, the application of technical science to agriculture; and second, a simplifying and cheapening of the systems of marketing and distribution.

³ The rise was due, no doubt, in the main to increased supplies, but their greater purchasing power enabled the populations of these countries to divert a larger share of the world's surplus directly (or indirectly in the form of feedstuffs) to their own consumption. Other countries, *e.g.*, those of Southern Europe, did not benefit in this way to the same extent.

been accustomed to alternations of seasonal plenty and scarcity in such animal foodstuffs as have been within reach of his purchasing power, and has perhaps not missed them very much in the long off-seasons. The town-worker, on the other hand, who now for nearly two generations, has been living within reach of transported supplies, has seen animal foodstuffs exposed for sale the whole year round and has been tempted to buy them whenever his circumstances permitted. The demand for animal foodstuffs on the part of town workers has thus to some extent been artificially created. In any case, there is less economic and social inertia in the progressive industrial towns, and changes in the style and the standard of living take place with greater ease and rapidity. Thus on these grounds also, the transference of population from the rural districts to the towns in countries of white population, results in a tendency to increase the per capita consumption of animal foodstuffs.

Owing to the fact that the mass of the working-class populations of Europe have hitherto shown in general a somewhat low rate of consumption of animal foodstuffs, this rate of consumption has been sensitive to special influences. The chief cause that has operated in restraint of a higher consumption among these populations has been their lack of sufficient purchasing power. Consequently the consumption of meat fluctuates more from year to year according to prices than does the consumption of the staple grains¹; further, in agricultural districts it fluctuates according to the yield of the harvests, and in the industrial towns according to the state of trade and employment.¹ Such fluctuations in working-class consumption have never been very considerable on the Continent of Europe, owing to the limits set by the comparative inelasticity of supplies. In Great Britain where meat has been imported duty free from all parts of the world the fluctuations have been more noticeable.

It is most important to observe that the per capita consumption of meat and other animal foodstuffs among the working-class populations of European countries is *per se* capable of considerable expansion. From this it follows that the consumption of animal foodstuffs in any given economic area depends less upon the resources and wealth of that area as a whole, than upon the distribution of the wealth between the various social classes of the population.² In general, the higher the rates of real wages among the industrial and working classes of European countries, the greater tends to be their per capita consumption of animal food-

¹ Schmoller, *Grundriss der Allgemeinen Volkswirtschaft*, para. 145, p. 603. For the influence exerted by the state of trade upon fluctuations in meat consumption see also (Cd. 2644), QQ. 388-9.

² Schmoller, *Grundriss der Allgemeinen Volkswirtschaft*, p. 595.—“The distribution of income in the nation according to the social classes influences the strength of the demand for essential and unessential commodities.”

In Great Britain also during the first two or three years of the European War, the per capita consumption of animal foodstuffs apparently increased beyond the pre-war level among the wage-earning classes, owing to higher average purchasing power.

stuffs. The constitution of the average European is such that he will almost always prefer to eat a liberal quantity of meat and other animal foodstuffs in preference to whole-meal bread, beans, and other vegetable produce, which, if taken in sufficient bulk, will supply the same nutrition values. This arises from several facts : first, that the human appetite, and particularly the European appetite, craves variety ; second, that a moderately liberal proportion of animal foodstuffs in the diet throws a much lighter burden upon the digestive system ; and third, that these foodstuffs stimulate both bodily and mental activity.¹

In view of the fact that throughout Europe the per capita consumption of animal foodstuffs among the working classes is limited on the demand side by the extent of their purchasing power, it follows that a cheap supply of cereal foodstuffs in any region, other things being equal, will increase the demand for animal foodstuffs ; the smaller proportion of the ordinary working-class family income that has to be spent on breadstuffs, the greater the proportion left for the purchase of the less essential articles of food in its dietary, of which animal foodstuffs are in practice the most prominent. Hence a tariff on imported cereals will tend to reduce the demand for, and the consumption of animal foodstuffs ; while the free importation of cereals including feedstuffs cheapens the bread supply and leads directly also to an increase in the production of animal foodstuffs within a country.²

In estimating the strength of the demand for animal foodstuffs in the future, account must be taken of three factors, namely, first, the probable increase in the meat-consuming populations, together with the distribution of that increase between countries of relatively high and those of relatively low per capita consumption of animal foodstuffs ; second, the probable changes in the rates of wages and the purchasing power of the working classes as a whole among meat consumers ; and third, the probable price-levels of the staple cereal foodstuffs.

Of these factors the first has been discussed at length elsewhere³ ; the second is of outstanding importance at the present time, and will require to be discussed at some length, while the third may be treated at once.

With reference to the world's supplies of food cereals, apart from war conditions, there is no evidence of any probable shortage in the future. An examination of the position in the period 1901-1911 shows that the production of food cereals increased on the

¹ See above Chap. iii., p. 228, Notes 1 and 3.

² It does this, first, by reducing the cost of the raw material in the form of feedstuffs required for animal rearing and thus cheapening the cost of production of animal foodstuffs within the country, and second, by causing a diversion of a certain part of the agricultural resources in the country that would otherwise be devoted to the production of food cereals, to animal-rearing industries.

³ See above, Chap. i.

whole at least as fast as the consuming population.¹ It has been noted in Part I., above, that new cereal lands still exist and are constantly being carved out of what have been hitherto pasture lands. In these the cost of grain production with modern agricultural machinery and facilities for transporting and handling the produce is low. It is believed that the increase in acreage under wheat and other cereals together with the upward trend in the average yields, removes any likelihood of a world shortage in these articles under normal conditions for many years to come.² This is the case in spite of the possible increase in the numbers of the world's wheat consumers in Asiatic countries and elsewhere: in spite also of the fact that the per capita consumption of wheat has shown a tendency to increase in countries populated by Europeans; and in spite of the fact that there may be further increases in the per capita consumption of some countries in the event of the tariffs that have hitherto been imposed upon imported wheat being reduced or abolished.³ Since cereal prices have in the past corresponded fairly closely to the fluctuations in production, it may be assumed that they will continue to do so in the future. If, therefore, no shortage arises in the supplies of food cereals in the near future, there is scarcely likely to be any marked increase in their prices to consumers beyond the general advance in those of all agricultural produce, and they may even fall relatively to those of other such commodities.

It is not accordingly to be anticipated that the cost of the staple cereals in the average European dietary will rise appreciably or will be effective in diminishing that part of the purchasing power of the working classes available for animal foodstuffs. In view of the fact that in most countries wealthy consumers form but a small proportion of the total population, it is scarcely probable that the competition of feedstuff cereals with food cereals for the use of land will become severely felt in the producing regions.⁴

¹ As we are here concerned especially with meat-consuming populations, the principal food cereal of these populations, namely wheat, may be taken as a guide under this head. Accordingly to Rew's estimate (Cd. 7271, p. 377) the world's wheat acreage per head of wheat consumers increased from .28 acres to .31 acres in the period 1901 to 1911, while there was in addition some increase in the average yield. Correspondingly wheat prices on the London market showed no advance beyond that of commodities in general in the same period.

² See U.S. Depart. Agric. Yearbook, 1909. Article by Cerealists in charge of grain investigations, Bureau of Plant Industry, pp. 259-272.

³ An increase in the per capita consumption of wheat in a given country may be due (a) to a substitution of wheat for other cereals such as rye, barley, maize and even rice; (b) to a more extensive use of cereals as a means of partially replacing animal foodstuffs; (c) to a rise in the standard of living all round.

⁴ When examined in detail the questions at issue here appear complicated. It is necessary to realise the interdependence of all prices for different kinds of agricultural produce. Farmers will substitute one crop for another, so far as they are able, according to their forecast of maximum profits. It would follow, therefore, that if the demand for meat (and other animal foodstuffs)

The future changes in the wage-levels and the purchasing power of the working classes among white populations, and especially in Europe, appear to depend mainly upon the progress made in industrial development and in the bargaining power of the workers in combinations. Industrialism advanced rapidly in the period preceding the war, and there is every prospect of further developments in the years following its close. The world's demand for manufactured goods, especially for those in which iron and steel are the chief raw materials, seems likely to be very great in the near future. Apart from the actual destruction caused by the European War, the stocks of most manufactured goods will be very low at its close. The provision of adequate food supplies will itself cause an extensive demand for manufactured material for the construction and equipment of transportation systems, and for agricultural appliances. This demand may not be properly satisfied for some time, but in this case the efficient production and transportation of foodstuffs will suffer and the tendency for production to fall short of consumption will be accentuated. When the first twelve years of the present century are considered in this connection, it is found, that not only was industrialism expanding in those regions such as Western and Central Europe and Eastern North America, where it was already established, but that new industrial and mining centres were springing into existence in regions that had previously been almost exclusively agricultural.¹ It seems fair to argue that this widespread and persistent movement is one of the tendencies of the times, which will reappear with unabated strength

became very great and their prices correspondingly high, some land that might otherwise be devoted to wheat may be diverted to the production of feedstuffs, and that greater quantities of grains other than wheat when produced might be fed to animals instead of being marketed for human food. Unless the supplies of cereals become very abundant relative to population the consequence of this process would be to raise cereal prices all round.

On the production side it may remain profitable to produce wheat and other food cereals, even if the prices obtained are somewhat low, because, generally speaking, the prices for cereals for feedstuffs would be still lower, owing to the greater amount of human labour and the loss of food values involved in the elaboration of the feedstuffs into meat and other animal foodstuffs. Thus in England in the period 1894 to 1913 wheat prices recovered more rapidly, and to a greater extent, than those of barley and oats.

On the consumption side the limitations of the general purchasing power have to be considered. Only comparatively wealthy consumers can regard a rise in the price of the staple cereal foodstuffs with indifference. The majority of consumers are relatively poor and must check their consumption of animal foodstuffs when a rise in the prices of foodstuffs in general, however caused, makes itself felt. Though probably not a conscious process, the action of the average consumer amounts in effect to this, that he chooses rather to have a cheap supply of wheat and forego to a certain extent his desired supplies of meat rather than attempt to satisfy his taste for the latter at the expense of raising the prices of both this and the former. As a matter of fact, he is compelled to cut down his consumption of animal foodstuffs when food prices begin to rise, unless wages and incomes rise also.

¹ Among countries populated by Europeans the most notable instances are Russia, Sweden, Holland, Italy and Canada.

at the close of the European War. Under these conditions the demand for animal foodstuffs is likely to increase correspondingly, provided the general purchasing power of the industrial workers does not fall owing to special causes.¹

The tendencies of the present time point also to an increase in collective bargaining on the part of industrial workers, which aims at securing for the average employee the highest wages obtainable and tends therefore to increase his purchasing power. It appears that British workers, at any rate, will demand higher real wages after the war than they enjoyed before it.

It seems almost certain also that the real wages of agricultural workers will rise in the near future, partly because agricultural labour in progressive countries will not be obtainable in sufficient quantities without increased remuneration, and partly because the prices for foodstuffs are likely to be higher, and the agricultural industry as a whole to be more prosperous for some time to come than has previously been the case. The result of any such changes would again be to lead to an increase in the consumption of animal foodstuffs which in a majority of rural districts in Europe has hitherto been unduly low.

Obviously, however, if higher prices for foodstuffs in general become established for some lengthened time in the future, the purchasing power of all workers will be diminished thereby, unless their money income rises. If, moreover, workers demand increased real wages enabling them to purchase larger quantities of animal foodstuffs and other articles that have hitherto been somewhat beyond their means, it is quite clear that this can be met only by more efficient production, either of the manufactured goods which they are employed in making, or of the foodstuffs which they consume, or of both.² Now the contentment of working-class populations depends to a large extent upon their ability to obtain the quantities and kinds of foodstuffs that they desire; and while breadstuffs are taken largely as a matter of course because supplies are normally cheap and sufficient, it is otherwise with meat and other animal foodstuffs which are usually consumed in much smaller

¹ It is difficult to foretell what the general conditions will be in European countries after the war. Some maintain that everyone will be poorer and have less to spend on animal foodstuffs. The purchasing power of the working classes may not, however, suffer much even under these conditions, but see pp. 251 and 316, below.

² A general rise in the standard of diet among European populations can arise only from general economic changes resulting in an increase in food supplies. Such results may be accomplished in several ways.

(a) A greater proportion of capital and labour may be devoted to food production and a smaller proportion to the production of certain manufactures and services, especially those of a luxury nature.

(b) Everyone may work longer and harder.

(c) Technical progress may increase the return in agriculture or industry or both.

(d) The undeveloped resources of the tropics in food products may be made more effective.

per capita quantities by the working classes than by other classes. The quantity of such foodstuffs that can be afforded from the ordinary working-class family income is in some measure a test of the purchasing power of that income; and the demand for higher real wages is in some measure a demand for an increased proportion of animal foodstuffs in the diet. In view of the industrial troubles that are apt to arise when workers are dissatisfied with their circumstances, the study of the means whereby increased, and at the same time, reasonably cheap supplies of animal foodstuffs can be produced and marketed deserves close attention.¹

The problems relative to these matters are of the greatest importance, since when the prices of the less essential foodstuffs rise beyond a certain level relative to wages, they cease to be consumed by the working classes except perhaps in small quantities and become more or less luxuries of the rich.² Now animal foodstuffs form the most prominent class of the less essential foodstuffs, because it is possible to maintain health and strength when only small quantities of them are consumed; but as they are strongly desired by most Europeans, including those of the working classes, they have passed into the category of conventional necessities. As such the average European feels it a great hardship if his consumption of them is severely restricted.³

The discussion has so far been limited to the change in the situation under progressive industrialism with reference mainly to the working classes. In all countries, however, where such changes have taken place on a marked scale, a large class has come into existence which in the purely agricultural state is exceedingly small. Whereas in the latter there has existed, and still exists, a very large proportion of peasants and agricultural labourers with correspondingly smaller proportions of landowners and traders, in the highly industrialised country the so-called middle class becomes increasingly prominent. This class which is now often quite numerous in proportion to the rest of the population, generally lives at a comparatively high standard and therefore consumes animal foodstuffs freely. As a rule, the more numerous the middle class is in proportion to the whole population, the higher will be the per capita consumption of animal foodstuffs; and the progress of industrialism,

¹ Some of the questions under this head have been touched upon in Part I¹ above.

² A tendency in this direction was observed in Great Britain just before the outbreak of the European War. Compare the following quotation: "If, as it would appear, less meat per head has been eaten in recent years the reduction may possibly be attributed more to the natural check upon consumption consequent upon higher prices than to deliberate abstinence."—Agric. Stat., Part IV., 1913 (Cd. 7551), Report by H. Rew, to Secretary, p. 286.

³ Under ordinary European conditions of life a small proportion of animal foodstuffs in the diet may be regarded as a necessity, the extra quantities consumed when the proportion is moderate may be regarded as a conventional necessity, while the further additional quantities consumed by the rich to make up their heavy proportion may be regarded merely as a luxury.

so far as it results in an increase in the proportion of middle-class population to the whole, tends to raise the per capita consumption of animal foodstuffs in any given country. Thus in the newer countries where, for the purposes of the consumption of foodstuffs, nearly all belong to the middle classes or to the wealthy classes, the per capita consumption of animal foodstuffs is unusually high.

There is little doubt also that the progress of industrialism tends to increase the proportion of those that may be termed wealthy, whose consumption of animal foodstuffs is normally very high, and in this way, too (though to a small extent owing to the limited numbers of the wealthy class), tends to raise the per capita consumption of such foodstuffs for the whole.

It appears that during the last century and a-half manufacturing industries have as a rule favoured the rapid growth of populations much more than agricultural industries have done. This seems likely to continue to be the case. Now industrial progress and manufacturing industries, while they have undoubtedly assisted in the cheapening of the production and transport of foodstuffs on the whole, have been devoted mainly to supplying other wants than those connected with nourishment. In view of the fact that the greater part of the world's productive agricultural land has now been occupied, it would appear that industrial progress cannot be of such striking service as hitherto in rendering cheap food supplies available in that direction where it has played a prominent part, namely, through the cheapening of transport ; and the increase in industrial population in the future, if it continues at the same rate, may tend to overtake food supplies, unless the proportion of animal foodstuffs consumed is reduced, or unless manufacturing industries can materially assist in the more intensive production of foodstuffs. Fortunately, however, for Europeans, there are indications that the latter will be possible on an increasing scale in the future. The conclusion forces itself once more that it is only by the adoption of more scientific and more efficient methods of agricultural production (in which manufacturing industries can play an important part), that the future supplies of foodstuffs of the desired kinds can be secured for the world at large.

In some countries populated by Europeans, the proportion of people living on the land is considerable, and the question of the rate of consumption among agricultural populations in general under changing economic conditions, may be more closely considered. It has been observed that improvements in the means of transport between country districts and centres of populations, and in marketing facilities, may have the effect for a time of reducing the consumption of such foodstuffs among the producers. So long as such articles as butter, cheese, poultry, eggs and bacon were not easily and profitably marketed elsewhere, the tendency was for the farmers and peasants, and in new countries even agricultural labourers, to consume the local supplies in liberal quantities ; but when prices begin to rise in a strengthening market, the

opposite tendency appears—consumption falls to a simpler standard since any surplus represents hard cash which is required to meet the extra charges due to rising land values and rents. However, the general reduction of consumption in the producing districts under these conditions is liable to be counteracted by causes working in the opposite direction; the increased prices for produce may leave a margin above the additional expenses, resulting in increased agricultural prosperity and a consequent rise in the standard of living. The rise in the rates of wages paid to agricultural labourers, which is at present observable in point of fact almost everywhere among European populations, may lead to some improvement in the notoriously low standard of living hitherto prevailing in this class throughout Europe.

One of the first results of such an improvement in the standard is to raise the heretofore meagre per capita consumption of animal foodstuffs. On the whole, therefore, rising prices for agricultural produce may result in an increased per capita consumption of animal foodstuffs in the producing districts of Europe; and so far from causing increased supplies of these foodstuffs to flow from them to the towns, may have the opposite effect in reducing the marketable surplus remaining above local consumption.¹

The consumption of animal foodstuffs tends to vary also with the severity of the climate; the colder the climate the greater the physical need for a high proportion of animal foodstuffs in the diet. Now in both Europe and North America there has been some movement of the "centre of gravity" of the population in recent times consequent upon the development of manufacturing and commercial centres more towards the colder North than the warmer South in each continent. In Europe also the northward movement of population has been assisted by the clearing of forests and the draining of marshes. Nevertheless, the movement in this continent has been in general a slow one, and though still in progress, is not

¹ Of course the total as opposed to the per capita consumption in the producing districts would be reduced, if improvements in the methods of production were to lead to a greater production per head, if fewer persons were employed in producing a given quantity of foodstuffs. Now to some extent this has already happened, because the business of food production for the world appears to be carried on by a constantly declining proportion of the world's population, at any rate among the white peoples. However, this change is greater in appearance than in reality because many elaborating processes formerly conducted in the country districts have been transferred to town factories.

It has been pointed out (Part I. Chap. x.) that, whereas the application of agricultural machinery has done much towards increasing the efficiency of production of cereal foodstuffs, hitherto little has been done directly in this way in the production of animal foodstuffs except in dairying. Labour charges threaten more and more to be the chief item of expense in the production of animal foodstuffs which, when wages are rising, works therefore under an increasing comparative disadvantage. Thus an increasing proportion of the available agricultural labour tends to be diverted to the stock-rearing industries in which the conditions are favourable to a higher per capita consumption of animal foodstuffs among the producers.

likely to be of much moment in the limited space of one or two decades to come. In North America the northward migration of the centre of population has been more rapid and is proceeding more actively than in Europe. Moreover, in those parts of North America where the population is increasing most noticeably, the winters are, on the whole, more severe in temperature than in the corresponding parts of Europe. It is possible, therefore, that changes in the distribution of the population of North America according to climatic zones may have some influence in maintaining or even increasing the present per capita consumption of animal foodstuffs. In the Southern Hemisphere, on the other hand, the conditions under this head tend to be more stationary than those in Europe and North America; the combined populations of the Southern Hemisphere lands is small, industrial areas are as yet unimportant, and any movement of the centres of population due to the development of mining or the increase of settlement, tends, on the whole, except perhaps in South America, to be northward into warmer latitudes.

Habit and custom in matters of consumption act with considerable force over limited periods of time. Standards of consumption that have become habitual to any generation are not easily altered, except under great pressure, during the life of that generation, and this applies with special force to the consumption of animal foodstuffs. A customary form of diet arises, and the expenses demanded by it tend to become regarded as necessary. The American or the Colonial eats meat in one form or another three times a day, and the wealthy European at least twice, and it matters little whether meat rations once a day would be sufficient or not. Habit and custom among these people render the change to a less liberal consumption of meat very difficult under ordinary economic conditions, and so long as supplies are available and purchasing power remains, little change in this direction is likely to take place. In Europe, where class distinctions are marked, the lower classes constantly tend to follow the example set by the wealthier in matters of consumption, and not less so in animal foodstuffs than in other commodities. So long as social distinctions attach to questions of diet, it will be rather the exception to find individuals breaking away from the general class custom by simplifying their dietary. A wave of economic prosperity in almost any area of European population causes a rise in the standard of living, which among the working classes appears particularly in the form of an improved scale of diet; and this is lowered afterwards only with considerable reluctance. Among English-speaking peoples, at any rate, the fact that meat is regarded as a more aristocratic article of diet than cheese or milk, which for the same cost furnish a higher proportion of the same food values, must be ascribed mainly to customary prejudice.

Certain sections of the world's white population have become accustomed to a somewhat liberal diet in animal foodstuffs, and

the tendency is to increase this rather than diminish it with the improvements in the economic position of manual and industrial workers. Any backward step in this direction is apt to be very repellant, even if dictated by sound economic considerations. A parallel and extreme case of the same kind is found in the settled habits of consumption of alcoholic drinks which are admittedly a wasteful method of consuming foodstuffs from the point of view of national economy. Habits of consumption, when once formed, may sometimes be quite arbitrary in their working, and show little regard for reasoned economic considerations. However uneconomical of agricultural resources the consumption beyond certain limits of meat and butter may be under certain circumstances, every effort may nevertheless be made to maintain the habitual rate of consumption; in some respects the pound of meat is apt to have the same semi-sacred position in the consumption of large classes, that the pint of beer or the cup of tea has among others. It is doubtful whether the majority of the white populations will adapt themselves readily to any future shortage in meat supplies, or will show any willingness, except under great pressure, to utilise to the full the available substitutes in their dietary.

It has been observed that there is a constant tendency among European populations to regard a temporary abundant supply of foodstuffs and other products of nature as inexhaustible. The apparent abundance of animal foodstuffs towards the close of the 19th and at the commencement of the 20th century is a case in point, illustrated in both the newer and the older countries; in the former probably because the original resources and supplies were great in proportion to the population; in the latter because large sections of the consumers living in towns were out of touch with the centres of agricultural production and were almost totally ignorant of the conditions under which their food supplies were produced. Whatever the causes, this attitude of mind, this taking it for granted that abundant actual supplies are a promise of a similar abundance in future,¹ produces habits of consumption, often wasteful, that tend to persist. It is true that hitherto no social or political machinery has been in existence in the various countries, still less throughout the international market for the purpose of husbanding immediate supplies and resources or of directing consumption with a view to the future.² On the contrary, competitive

¹ So far from this supposition being correct, the reverse is not infrequently the case; abundant supplies of meat for example in a given season may mean a considerable shortage in the following years. Thus in 1911 meat was abundant in Western Europe because, owing to the general drought of that year, it became impossible to carry the usual numbers of live-stock through the following winter and animals were consequently rushed, in many cases prematurely, to slaughter. (Compare Part I., p. 2, Note 2).

² The pressure exerted by war conditions in the countries of Western and Central Europe and, to some extent, in North America, has caused the various governments to organise food-control departments which may be of service this direction in the future.

trade has rather favoured the maximum immediate production and consumption at whatever cost to the future. Animal foodstuffs have been especially open to abuse in this way because the consumption of them is in Europe highly elastic, and because the production of them causes, as has been shown, a heavy drain upon agricultural resources which cannot always be maintained or replaced. Neither public opinion nor the various State governments have been alive to the importance of regulating consumption in accordance with the conditions of immediate and future supplies.

The amount of waste is another factor that influences the rate of consumption of animal foodstuffs. This question has not been as yet carefully investigated, but it is known that the total quantities of animal foodstuffs that are lost by waste in different ways are by no means inconsiderable. Much of this waste is of such a form as to be avoidable with proper organisation and management.

Waste occurs in connection with perishable foodstuffs such as those of animal origin in all stages between the first steps in production and the final act of consumption as food, owing to deterioration of quality, if not actual putrefaction.¹ In the fields of production and wholesale distribution much has been done to reduce waste by the introduction of cold storage, but in retailing and in the field of consumption, much waste arises in warmer climates, and during the warmer season of the year in cooler ones, merely through the tendency to putrefaction.²

Great distances in the newer countries frequently separate the farms whence dairy and poultry products originate from the consuming centres, and waste is apt to arise by deterioration and by the first stages of decay both before the goods leave the farms and while they are in transit. Transport facilities in such regions are often poor, and perishable products sometimes pass through the hands of a chain of intermediaries; both of these circumstances naturally tend to loss by wastage.³ The waste due to bad market organisation and to inadequate cold storage facilities on the producing farms and in the consuming households is largely involuntary so far as individuals are concerned. It can only be reduced by better social organisation, by remedying the present defects in the facilities for the proper storage of small quantities, and by simplifying the present systems of marketing. Waste from this cause is much

¹ In the United States it has been estimated that 30% to 40% at least of the entire production of perishables (including dairy produce, poultry and eggs, fruits and vegetables) in that country are lost through decay before reaching the consumer.—Columbia Univ. Research Series, "Marketing Perishable Farm Products," 1911, p. 25.

² The high rate of loss from this source in Australia (where cold storage facilities are inadequate) has been given as one of the reasons for the extraordinarily high per capita consumption of meat in that country.

³ The loss of eggs, for example, in the United States, arising from improper handling on the way to the consumer has been estimated at 17% of the total production, and is said to have represented a value of 45 million dollars annually.—U.S. Dept. Agric., *Bulletin* 141, Bureau An. Ind., 1911, p. 11.

less common in Western Europe than in the newer countries, because in the former transport facilities and market organisation are more complete, because the climate is in general cooler, and because, moreover, people are more economical by the force of circumstances in their habits.

A considerable element of waste in all foodstuffs, and not less in animal foodstuffs than in others, is due to heedlessness, prejudice or ignorance on the part of consumers. In ordinary times, for example, among rich and poor alike, a distinct preference is shown for certain cuts of meat rather than others and for lean meat rather than fat meat.¹ The result is that certain less desired cuts and certain parts of the fat of the "finished" animal which cannot be easily separated in retailing, tend to be wasted; the former, if not sold to the poorer people, are probably converted largely into sausage-meat or fed to domestic animals such as cats and dogs, while the latter may often be actually thrown away.

Among the rich there has apparently been considerable extravagance in the consumption of animal foodstuffs in the past. Excessive quantities of meat have been customarily consumed by them, while other foodstuffs which are more cheaply produced have been used in correspondingly smaller quantities. Butter has similarly been consumed excessively by this class, mainly through being used extensively for cooking. The proportion of pure waste is apparently greater in this class than in others,² and larger quantities are wasted from the human point of view, by the wealthier class also, through being used for the maintenance of unproductive animals kept for sport or as pets. It should be noted that the large staffs of servants usually maintained by the richer classes tend to live at the same standard as their employers in the matter of animal foodstuffs. From the strict physiological point of view excessive consumption of meat and other animal foodstuffs is to be regarded as wasteful, since the excess of protein, at any rate, is not utilised to anything approaching its full food value in the economy of the human body.³ There appears, however, to be little likelihood that the wealthier classes among the white populations of the world will materially reduce their consumption of animal foodstuffs in the future. The present standard has become too firmly established through habits bred throughout many generations, to be easily altered. Here again, the tendency is illustrated for conventional

¹ See Chap. iii., above, p. 231.

² Investigations made by a Government Department in the United States showed that the proportion of wasted foodstuffs in families whose income was less than 800 dollars per annum averaged 3% to 4%, while that in families whose incomes were between 1,000 dollars and 3,000 dollars averaged 10% to 25%.—*Journal of Political Economy*, Chicago, Feb., 1916, p. 163.

³ Animal foodstuffs, except butter, contain a high proportion of protein which, in the economy of the human body, is required for growth and for the renewal of wasted tissue. Excess quantities of protein consumed above these requirements are converted into energy, which, however, can be much more economically obtained from starchy foods.

standards of living to persist, even in spite of altered circumstances demanding perhaps some modification of them. Without trespassing upon the province of the social reformer, this economic fact may be pointed out: that in face of a general shortage of animal foodstuffs, whether actual or threatened, or of a rise in the prices of all foodstuffs consequent upon a tendency for the world's consumption to overtake its production, any excessive rate of consumption on the part of particular classes has the indirect effect of increasing unnecessarily the price for all consumers. This applies especially to animal foodstuffs which require a large share of agricultural resources in proportion to their food values; a relatively small increase in the production of these foodstuffs may, if the law of diminishing returns operates, cause an appreciable rise in the cost of production and also in the price of breadstuffs. If it is desirable that all classes in the various communities should be properly nourished at a reasonable cost, then it is undesirable that any section, whether large or small, should consume more of such foodstuffs as make high demands upon land resources than is adequate for their full nourishment.¹

Waste in the matter of the consumption of animal foodstuffs occurs in all classes, when through ignorance, carelessness, or lack of time and proper appliances, the foodstuffs are badly or wastefully prepared. Inferior and uneconomical methods of cooking appear to be commoner among English-speaking peoples than on the Continent of Europe, where the art of making the utmost of relatively small quantities of meat is much more highly developed.² Bad cooking leads both directly and indirectly to waste; directly because parts of the foodstuffs are destroyed or fail to be utilised, and indirectly because the ultimate food value depends to some extent upon the ease and completeness with which the foodstuffs are digested in the prepared form.

The threatened, if not actual, shortage of animal foodstuffs by raising prices tends to lessen waste among all classes except the wealthy, who, however, may be indirectly impelled by the force of public opinion or through their own public spirit to reduce any waste of animal foodstuffs in their households to the lowest limits. The waste of animal foodstuffs which has occurred in various forms in

¹ The current ideas on the economics of consumption are generally vague and inaccurate. It has naturally been to the advantage of the trading and producing communities that demand should be keen, so that price levels may be maintained and business remain secure. This may be one of the causes for the rooted idea that excessive and extravagant consumption of foodstuffs as well as of other goods is a benefit rather than a disadvantage to the community. This idea may also be derived in some measure from past times when it appeared that the production of goods outran consumption. Sufficient has been said to show that the notion is false economics as regards animal foodstuffs, at any rate, at the present time.

² Compare the following extract from Marshall's *Principles* (V. VI., para. 2): " . . . many kinds of meat and many parts of vegetables which are almost valueless in America where skilled cooks are rare have a good value in France where the art of cooking is widely diffused."

both Europe and the newer countries, is more or less under human control. So far as it becomes reduced or eliminated in any or all the countries where such foodstuffs are produced and consumed, the value of the supplies in the consumption of the future will be correspondingly increased.

The principle of substitution has already been referred to in the preceding chapter dealing with food values. As an economic factor influencing the rates of consumption of the different animal foodstuffs and of all such foodstuffs taken together, this principle naturally causes a displacement of more expensive articles of food by others that serve the purpose equally or nearly as well. It is to be observed, however, that the process of substitution, in the matter of foodstuffs especially, is apt to be impeded by the friction arising from the inertia of established habit and of conservatism. The most prominent examples of substitution which are likely to have an influence upon the consumption of animal foodstuffs, are those of fish and of cheese for meat, of vegetable oils in the form of of margarine for butter and of skim-milk for whole milk for household consumption. No very great progress has hitherto been made in any of these directions, except in the utilisation of vegetable oils for butter substitutes. Among European peoples there was probably some increase in the per capita fish consumption in the last two decades previous to the outbreak of war, though fish was scarcely regarded as a substitute for meat among the well-to-do classes, but rather as an additional course. The per capita consumption of cheese actually fell in the United Kingdom between 1890 and 1910 owing to the more or less abundant supplies of imported meat, and it does not seem to have risen noticeably in any important area. In point of fact, there was no sign of an actual meat shortage in Europe till after the year 1906 and the short period that elapsed between the time of the first noticeable shortage and the outbreak of war was not sufficient, nor was the shortage ever acute enough, to cause any extensive processes of substitution to come into operation. The wholesale disturbance of the previously established standards of consumption caused by the war, and the conditions of shortage in meat supplies that are likely to obtain at its close, will probably bring about considerable substitution in Europe of both fish and cheese for meat. It has been already observed that butter may in the future become more or less a luxury of the rich.¹ With regard to the substitution of skim-milk for whole milk little progress appears to have been made, except in the poorer dairying districts where skim-milk has always been an important article of food. Nevertheless for many domestic purposes skim-milk, if clean and fresh, is nearly as good as whole milk, especially for cooking purposes. The obstacles in the way of its wider use among town populations hitherto have been firstly

¹ See above, Chap. ii., p. 213.

prejudice, and secondly the difficulty of obtaining it thoroughly fresh and at the same time fit for human consumption.¹

It is important to notice that so far as substitution in any of the above forms becomes effective among consumers, there results a saving of agricultural resources without any necessary decrease in the nutritive value of the dietary.

Among vegetarians it is held that nuts and other plant food-stuffs of similar chemical composition can be used as a complete substitute for meat, and similarly that vegetable oils can replace butter and animal fats. The proportion of thorough-going vegetarians among the various white populations is quite small, and if increasing, is doing so at a slow rate. There is not, therefore, much likelihood that the per capita consumption of animal foodstuffs will be appreciably reduced in the future by a spread of voluntary vegetarianism in its pure form. Partial vegetarianism which dispenses with meat from the diet, but admits the use of dairy products and eggs, seems more suited to the taste of the average European than the former, and is therefore perhaps capable of greater growth in the future. Modified forms of the latter, which aim at reducing the consumption of flesh, without eliminating it as a matter of principle, also exist. It should be noted that all forms of partial vegetarianism, while reducing meat consumption, tend to increase almost correspondingly the consumption of fish and especially of dairy products and eggs. They may not therefore materially relieve animal food supplies as a whole, except in so far as less agricultural resources are required to produce a given unit of food values in the form of the substitutes than in the form of meat. Since, however, an acre of land will produce more food-units when used for dairying than when used under similar methods of cultivation for meat production, there is some advantage in the saving of food supplies, through substituting the former for the latter in consumption. So far as vegetarianism in any form results in the substitution of plant foodstuffs for animal, there is a distinct advantage in that direction.

The age-constitution of any given population will, other conditions being the same, influence the per capita consumption of animal foodstuffs and especially of meat. In many countries populated by Europeans there has recently been a general decline in the birth-rate accompanied by a decline also in the death-rate. The effect of both of these changes is in the same direction, namely, to raise the age-constitution of the population, or, in other words, to increase

¹ Under the old farm dairy system in which the cream is obtained by skimming after the milk has been standing 12 hours or more, the skim-milk will stand transportation and retailing only in cooler weather, while under the creamery system the separated milk obtained is not of much value as human food. It might, however, be possible to utilise milk to greater advantage by withdrawing part of the cream as soon as possible for margarine production and by disposing of the valuable remaining product for human consumption in place of whole milk.

the proportion of adults to the whole population.¹ Now, on the whole, the greater the average age of a given population, the greater will be the per capita consumption of foodstuffs ; and this is especially the case with meat and some other animal foodstuffs, which are consumed in but small quantities by infants and young children. Among animal foodstuffs milk is the only striking exception, though the extra quantities of milk consumed by children under 7 or 8 years of age does not suffice to bring their normal consumption of animal foodstuffs as a whole to anything approaching the level of the average working adult in the same population. It may be said that older people beyond the prime of life consume less foodstuffs than younger and more active people, though it is probably also true that the quantities of concentrated foodstuffs consisting mainly of meat and dairy produce consumed per capita, do not diminish perceptibly in the diet of most people as they grow older. Again, a decline in the birth-rate may have this important consequence that it increases the income available for the purchase of foodstuffs per unit of the family, and thereby lead to an increase in the quantities of animal foodstuffs consumed by all members of the family. This is especially true wherever the family food budget is limited by considerations of incomings, as in the case of the working classes, which, after all, form the great bulk of European populations. Clearly among the working classes, where family incomes tend to a more or less uniform level, the per capita consumption of animal foodstuffs, that is, of the more costly forms of nourishment, is likely to be greater in those families in which there are no children, or only one or two, to be provided for, than in those where the number of dependent children is numerous.

It follows that calculations concerning the per capita consumption of animal foodstuffs, which are consumed in greater per capita quantities by adults and by those of greater relative means, are not comparable for different periods in the same countries, nor for different countries at the same time, unless some account is taken of changes or differences in the age-constitution. Changes in the age-constitution are most noticeable among the more advanced countries of white population, and one of the more striking social effects of the European War is a further marked decline in the birth-rate of the countries closely involved in the conflict. Apart, therefore, from army casualties, it will be found that the proportion of adults in the near future in these countries will be higher than ever before.

¹ A decline in the birth-rate, even if the rate of infant mortality is at the same time somewhat lowered, raises the average age, while a decline in the death-rate, unless confined to infants and children which in actual experience is not the case, also raises the average by sparing to older years those who would otherwise have disappeared from the population.

CHAPTER V.

THE ECONOMICS OF THE PRODUCTION OF ANIMAL FOODSTUFFS IN RELATION TO CONSUMPTION.

IN Part I. above, attention was drawn to the fact that in all cases, and especially when agricultural resources are limited with reference to the tributary population, the requirements in food crops have a prior claim to animal industries for the use of land. In other words, the latter tend to be residual and to that extent are in a weak position relatively. Nevertheless, even without the pressure of a strong demand for animal foodstuffs, to whatever extent animal industries are incidental to the production of food crops, they tend to remain permanent, and any development that increases this incidental feature strengthens their position. The present chapter is devoted mainly to a study of this question of incidental production.

The whole subject can be most conveniently studied by supposing for the time being that the demand for animal foodstuffs were non-existent, that the foodstuffs necessary for human subsistence were derived entirely from the plant kingdom, thus rendering food-producing animals also superfluous.¹ For added convenience meat may be taken to represent the whole class of animal foodstuffs in this study.²

The temperate regions of the world, together with the tropical highlands, contain in their natural state vast areas of native pasture lands, which under the above supposition would represent so much waste land till taken over for crop production, except so far as a small proportion of it might be used for the maintenance of horses. Much of this land, however, consisting of mountain slopes, would not be easily cultivated and might remain unutilised for an indefinite period of time. In any case, the needs of the world's existing population in the matter of plant foodstuffs could be abundantly satisfied without bringing the whole of even the easily cultivated surface into use. Such animals as might live on the unoccupied grasslands would have no food value and might be left in their natural habitat, more or less undisturbed; if they came to be killed for any reason or purpose, the meat derived from them would be practically a waste by-product under our supposition.

¹ For the purpose of simplicity the demand for wool and leather, met at the present largely from food-producing animals, is neglected under the supposition.

² The suppositions made have no claim to historical accuracy, as no account is taken in the various stages suggested of the domestication of animals for meat production; they are entirely hypothetical and represent a method of analysis common in economic writings.

If it is supposed, further, that a section of the human population developed at this stage a taste for limited quantities of meat, they might get such supplies as they wanted at a price covering merely the costs of marketing, just as obtains at the present time in the case of the supplies of drinking water in well-watered countries. This would be the case so long as the total consumption of meat by such people was less than the total quantities incidentally produced from the herds of wild animals.

Even if it is supposed that the total consumption of meat by meat-eaters tended to exceed the supplies obtained as a by-product from the animals found in these waste pasture-lands, the price of the meat might not rise much above the total costs of marketing. Owing to the conditions of farming in temperate latitudes, where some rotation of crops is necessary, and where there is necessarily some waste fodder and herbage unfit for human consumption, even when the requirements of working horses have been provided for, a limited number of meat-producing animals might be kept at a purely nominal cost, merely to consume what would otherwise be waste fodder. In other words, a limited number of meat-producing animals are incidental to the production of food crops and the meat obtained from them represents, as it were, a by-product of such farming. So long as the total consumption of, and the total demand for, meat did not exceed the supplies available incidentally from the wild herds and from the animals living, so to speak, as farm scavengers, taken together, the price of meat might not appreciably exceed the costs of preparation and marketing. It would scarcely exceed these at all, if meat-consumers were indifferent and the demand very elastic, so that the smallest rise in the supply price caused a marked contraction in the consumption. The latter would still be within the limits of supplies from incidental production.¹

If it is now supposed that the number of meat-consumers becomes greater and their demand for meat keener and less elastic, so that the supplies derived from any wild animals existing on the unused pasture land, together with those kept incidentally in crop farming, are no longer sufficient, then new conditions appear, representing in a simple form those obtaining in countries populated by white people at the present. Prices will rise above the costs of collection and marketing, and will contain something in the way of costs of production. The native pasture lands will acquire economic value, and some human control will be exerted on the raising of animals upon them, with the object of increasing the supplies of meat, the enhanced price of which will repay a certain amount of labour and trouble expended in this direction. Similarly also, more attention will be given to the rearing of meat-producing animals upon crop farms, and if the demand continues to grow, some part of the land resources that would otherwise be devoted to crops may come to be utilised for the feeding of such animals.

¹ See Chap. ii., Appendix, p. 225.

Under actual conditions, throughout those parts of the world controlled by white peoples, the consumption of meat and other animal foodstuffs has risen to such a point in proportion to the available areas of natural pastures that the rearing of food-producing animals has passed far beyond the stage of being a mere incidental factor in general farm economy ; it has indeed become one of the principal branches of agriculture. Large areas of valuable agricultural land that might theoretically be utilised for producing crops for human consumption are laid down to pastures for animals or remain as natural pastures for the same purpose ; many millions of tons of maize and other cereals are grown for the express purpose of providing feedstuffs and fattening material for food-producing animals ; and further, large areas are devoted to fodder and root crops for the same end. Altogether, vast agricultural resources, in addition to those in the form of natural pastures, are employed in the business of producing animal foodstuffs. In Europe, North America, South America and Australasia, taken together, it is probably no exaggeration to say that at least one half of all the crops grown in any given year (excluding the produce of all pastures except hay crops) is ultimately used as feedstuffs for food-producing animals.¹ Certainly considerably more than one half of all the land produce, including grass from pastures, is so utilised in these four continents.² Nor is this all, because large sums of capital have been expended in the improvement of live-stock, in the farm buildings for housing them, and in the plant and machinery on and off farms, used directly or indirectly in the production and preparation of animal foodstuffs.³ The production of these foodstuffs has become a very elaborate and costly business. It competes severely in most temperate countries with the production of food crops for

¹ Figures available for the United Kingdom serve as an indication of the proportion of crop-produce devoted to animals. The average total supplies of grain of all kinds available in the United Kingdom in the period 1909-13 were 16.9 million tons, of which 9.2 million tons were fed to animals, including horses (Wood, *National Food Supply*).

If feed-cakes are included and the oats fed to horses deducted, then food-producing animals consumed about one-half of the supplies ; but the animals of the United Kingdom produced only about one half of the total British consumption of animal foodstuffs, taken together, and in order to do so consumed an additional 61 million tons dry weight of grass and other fodders. (Wood, *National Food Supply*, p. 19).

² A difficulty occurs incidentally in finding a common unit of measurement for land produce in the form of different crops. The ton dry weight is simple and easy to calculate, but the ton of starch equivalent is more accurate scientifically owing to the difference in feed value between, say, a ton of maize and a ton of hay, both dry weight.

³ In the United States, for example, according to the Census Report for 1910, the value of the farms and property with live-stock as the principal source of income was 15,000 million dollars, while the value of the animals accounted for an extra 3,400 million dollars. The value of the wholesale packing and refining establishments was nearly 400 million dollars in addition. The total capital value was therefore nearly £3,800 millions. No capital employed in the retail trade or in transportation is included.

the use even of arable land, and there can be no doubt that this competition has raised land values and consequently the cost of all foodstuffs of temperate origin beyond the level that would have obtained, if the existing population had been able, or had chosen to subsist entirely upon plant foodstuffs.

The fundamental point in the economics of the production of animal foodstuffs in relation to consumption appears therefore to be this : when the consumption exceeds the limited supplies obtained from pasture lands unsuitable for cultivation together with those produced on farms as a kind of by-product in food-crop production, the price of animal foodstuffs rises, not only because demand is greater than natural supply,¹ but also because the competition exercised by the increased production of such foodstuffs, upon the available agricultural resources causes the value of *all* productive land, and the costs of all agricultural production to rise. Evidence of this appears in the remarkable rise in land values that has occurred in all important agricultural areas within reach of the world's markets, with the exception of Great Britain, where the conditions have been peculiar. In a general way, as noted above,² it is the increased demand for agricultural produce, following upon an increase in the consuming population, out of proportion to the increase in the utilised area, that has caused this rise in land values ; in reality, however, it is rather the increased consumption of animal foodstuffs that has been mainly responsible for the increased strain upon the world's agricultural resources. Investigations show that the prices of meat and other animal foodstuffs remain comparatively low compared with that of breadstuffs so long as food-producing animals are maintained on pasture land not required for food-crops. When they compete with human beings for the produce of cultivated land, the price of meat rises and finally settles down at a much higher level proportionate to that of breadstuffs than in the earlier stages of exploitation ; thence forward it tends to move parallel with it.

There is thus a kind of critical point (marked by the commencement of this competition) in the price-level of meat compared with that of breadstuffs ; this point has, of course, been passed in Western Europe ; it has just been reached theoretically in North America ; and it is still to come theoretically in South America and Australasia, which produce far more both of breadstuffs and of animal foodstuffs than they require for local consumption. The rise of the world market for the principal foodstuffs and the growing deficiency of Western Europe in animal foodstuffs has raised the

¹ If the rise in the price of meat and other animal foodstuffs since about the year 1905 were due entirely to shortage, then stock-farmers would have been making abnormal profits, but there is ample evidence to show that this was not the case in the leading European countries. If the ordinary conditions of supply and demand had obtained there would have been an immediate and considerable increase in live-stock production in all suitable countries, but this is not shown to have been the case from trade statistics.

² See Part I., Chap. xii.

prices of the latter in the newer countries, especially those of the Southern Hemisphere at a rate out of all proportion to the real costs of production, and the difference has appeared in a remarkable rise in the values of accessible pasture lands in those countries. The latter areas have benefited by the fact that in Europe and, to a limited extent, in North America, the critical point has been passed and food-producing animals are now actively competing for the produce of arable land. In the past when countries were economically much more isolated than under the present world-market conditions, changes in the comparative prices of meat and breadstuffs were much more noticeable in individual countries. In both France and England between 1800 and 1900 the average prices of meat rose much more in money values than those of wheat.¹ This was due chiefly to the fact that the critical point, above referred to, was passed in these countries during the 19th century, though it was also partly due no doubt to the fact that higher yields and the introduction of machinery, together with cheap imports, tended to keep down grain prices relatively.

Except where there are unlimited areas of pasture lands, which are either not capable of cultivation or are too remote from the world's markets to be so used economically, animal foodstuffs are a costly form of nourishment in terms of agricultural resources. On an average a given area of land capable of cultivation will support from eight to ten times as many people when producing plant foodstuffs consumed as such, as it will when made to produce animal foodstuffs under the same methods of cultivation.² If, instead of being cultivated, such land is laid to pasture, the

¹ See *Essais d'Economie Sociale*, 1871 (edited by Imbart de Latour), p. 148. "The price of meat has always followed an upward movement; that of beef, which cost 5 or 6 sous a pound in the last century, and 11 to 12 sous thirty or forty years ago, now amounts to 22 to 24 sous and the price tends to rise further."

Imbart de Latour (*La Crise Agricole*, p. 26) quotes the following figures from Yves Guyot, showing the rise in meat prices and in wheat prices in France and in England between 1790 and 1880 :—

	INCREASE IN MEAT PRICES.	INCREASE IN WHEAT PRICES.
France	275%	15·8%
England	200%	nil (bread)

The greater increase in meat prices in both countries is due partly to a marked increase in the effective demand for meat; but changes in the methods of production account for some part of the difference. In the 18th century grazing land was relatively plentiful and meat was produced with little labour at a time when wages were low. During the 19th century, owing to developments in agricultural machinery, the labour-costs of producing wheat fell considerably, while, on the other hand, owing to the necessity which arose for the stall-feeding of meat animals in these countries, the labour-costs of producing meat rose sharply. The difference in the market prices of meat and wheat in Europe about 1880 was due also in some measure to the greater transportability of wheat produced cheaply in North America.

² A. D. Hall, *Agriculture after the War*, p. 89.

difference is still greater. On the other hand, it has been observed above (Part I., Chap. viii.) that under the present systems of farming animal industries are essential for the maintenance of permanent fertility in most parts of the temperate regions and especially where artificial fertilisers are not easily obtainable. It is to be observed, however, that owing to the great demand for animal foodstuffs, animal industries have often become the main rather than a subsidiary branch of farming, and that under these conditions the land is not being utilised in the most economical way, absolutely and apart from any considerations of profit, for the production of human food. From investigations that have been made it appears that even the most economical of food animals consume about 12 lbs. of dry matter in feedstuffs and fodders to produce 1 lb. of dry human food, and sheep and beef cattle, if kept till mature, much more.¹ With regard to the materials so consumed it clearly makes all the difference whether they are obtained incidentally from, or in competition with, the production of food-crops. Unless the existing methods of agricultural production become rapidly intensified, or unless the production in the hitherto undeveloped or partially developed regions makes rapid progress, it appears that in the near future the white populations of the world cannot increase their per capita consumption of animal foodstuffs without increasing their food bills disproportionately. While a relatively small increase in agricultural resources is necessary to supply the food requirements of each addition to the population, in plant foodstuffs consumed as such, a comparatively large increase in such resources is required to supply the food requirements of the same additions, when animal foodstuffs form a marked proportion of the whole diet. It may be that the average European may have to choose in the future, consciously and as a matter of social policy, between a fairly cheap diet with little meat, and a fairly costly one containing a liberal proportion of meat.

We may now pass to the study of some special applications of the principle of consumption in relation to incidental production, with reference to actual economic conditions.

I.

Under the existing conditions of a threatened shortage of animal foodstuffs, the question of soil fertility, already referred to,² has considerable bearing upon the economics of animal husbandry in relation to the consumption of animal foodstuffs. It has been shown that to some extent animal produce is a necessary outcome, and in extreme cases, of the nature of a by-product of well-conducted farming operations. From this point of view the consumption of animal foodstuffs in limited quantities is justified by considerations of agricultural economy. The question arises to what extent the

¹ See Wood, *National Food Supply*, pp. 33-5.

² See Part I., Chap. viii.

rearing of animals is essential to the preservation of fertility ; could the present huge dimensions of the animal-rearing industries be appreciably reduced in the leading areas without risking the impairment of soil fertility ? In answer to this question it may be urged that so far as food-producing animals are maintained on concentrated cereal feedstuffs, they could be dispensed with without reducing in any serious degree the fertility of the world at large. The effectiveness of animals as a means of maintaining or increasing soil fertility lies, of course, in the return made to the soil in the form of manure, and in some cases also in the form of waste slaughter-house products. Obviously the degree of effectiveness depends, too, upon the manner in which the fertilising elements are collected, stored and returned to the land. To whatever extent avoidable waste occurs in this matter, the necessity of live-stock as a means of preserving fertility is needlessly increased. Moreover, if the fertilising elements in sewage material could be economically collected and returned to the soil without the admixture of deleterious substances, the necessity for utilising live-stock incidentally as fertilising agents would be considerably reduced in the regions of dense population. The systems of sanitation in modern European towns are based on the principle that sewage material is something to be got rid of as cheaply and efficiently as possible, rather than that it is capable of practical utilisation as a fertilising agent. Attempts have been made to deal effectively with the sewage refuse of certain large towns, so as to turn to use the fertilising elements contained, but without any great measure of success. The problem, however, is being attacked in various countries and some progress, possibly great progress, is to be anticipated in the near future.¹

The most effective means, however, of dispensing with live-stock as a means of correcting loss of fertility, lies in the more extended use of commercial fertilisers.² These can be used to supplement farmyard manure, and with a judicious use of green-manure crops can even replace it entirely. As the output of such fertilisers increases, live-stock can, in the event of pressure, be more and more dispensed with without loss of fertility in those regions that are within easy reach of supplies of these substitutes. Such regions are naturally the more densely populated industrial ones, and it is in them accordingly that farmers will first become more independent of animal industries in this respect. It is possible in the future that meat production will decline relatively in regions of large industrial population except so far as it is incidental to dairying,³ and it is certain that dairying will be devoted in the first place to the production of whole milk, which, of all foodstuffs, is

¹ See Final Report of Royal Commission on Sewage Disposal (Cd. 7821) and various previous Reports.

² See Part I., Chap. viii.

³ The amount of meat that may be produced incidentally to dairying can be a large item. It includes beef from discarded cows, veal from the calves, and even pork and bacon from pigs fed in part with skim-milk and whey.

least able to bear long transport. It must be remembered, however, that vast areas of farm lands, especially in the newer and more distant countries, will remain for a long time so far removed from the centres of production of commercial fertilisers, that they may have to depend increasingly for years to come upon animal industries as the principal means available for the preservation of fertility. In these more distant areas, now largely engaged in grain production or in stock-rearing on pastures, the population is, and will remain for some time to come, relatively sparse, and from them larger surplus supplies of meat, cheese and even butter, may be expected to be available to meet the deficiency in the densely populated industrial regions of Europe.¹

The displacement of horses both on farms and in towns may result in a diversion of grain consumption from horses to food-producing animals or even to human beings, if wheat be substituted for oats.² Motor traction is developing rapidly at the present time for commercial vehicles and even for agricultural implements; for the latter purpose the movement is most marked in the more important cereal-producing countries such as the United States, Canada and Argentina, where there are extensive plains, and where the holdings are large, but motor traction is also being applied to agricultural operations in Europe, especially in Eastern Germany.³

In connection with the present discussion, it may be observed that the more remote agricultural regions may be almost compelled, in order to preserve soil fertility, to substitute food-producing animals in farm economy, as fast as horses are displaced by motor power; thus the incidental production of animal foodstuffs may be increased. In any case, every addition to the motor power employed on farms increases the net agricultural resources available for the production of foodstuffs for human consumption throughout the world; and if some of the newer and more remote agricultural regions continue to produce grain exclusively, the increased surplus arising from the displacement of horses may be sent to countries of the elaborating-commercial type, and be there converted into animal foodstuffs. Incidentally, it is to be observed

¹ It has been shown in Part I. that animal industries in the densely populated countries of Western Europe depend in no small measure upon imported supplies of concentrated feedstuffs which may or may not be so readily available in the future. These industries will tend to remain there on a large scale, however, for two special reasons; first, because they enable efficient use to be made of farm labour and of crop rotations, and second because of quasi-political considerations, each nation desiring to assure as complete a food-supply from its own territory as possible.

² See Part I., Chap. xi., p. 160.

³ The motor-driven farm tractor is not likely to be introduced so rapidly in the more densely populated countries of Europe, because, firstly, it is not economical as yet on small holdings; secondly, labour is comparatively cheap; and thirdly, oats (which are the chief feedstuff of working horses) grow particularly well in Western and North Western Europe. On the other hand, it is precisely in these countries that displacement of town horses by motor power for vehicles is likely to be greatest.

that the development of motor transport and equally also of farm tractors ¹ tends to cheapen and to increase the efficiency of the whole business, not only of production, but also of the marketing and distribution of foodstuffs.²

II.

The world depends upon animal industries for its supplies not only of animal foodstuffs, but also of such joint products as leather, skins, wool, glue, and hair; and the prices of animal foodstuffs, and in some measure the extent and the nature of animal industries depend upon the demand for these joint products.³ If it is supposed for a moment as before, that the white populations of the world consumed little or no animal foodstuffs, the demand for wool and leather might still remain, but farm animals would be specialised for the production of these articles without any regard to their capacities for the production of meat and other foodstuffs. The demand for animal foodstuffs being what it is, the production of wool and leather tends to be incidental to that of the former in animal-rearing industries; an exception arises, however, in some cases of extreme specialisation in sheep-rearing, when wool becomes the main product and tallow and meat the subsidiary joint products. In the main, however, apart from specialised wool-sheep, these joint products are inseparable from the production of animal foodstuffs, though the quantities produced do not bear a constant ratio to the quantities of animal foodstuffs produced. As will be seen later, this ratio tends to decline as time passes. Now the present consumption of these joint products tends to overtake the production, and the demand for them, therefore, tends to stimulate the business of rearing the animals that produce them. To return to the supposition above made, if the demand for meat were to vanish, the demand for these joint products remaining unaltered, then the total number of wool and leather-producing animals would have to be maintained at nearly the present level, unless by breeding animals exclusively for these products a higher return per animal were obtained. Under this supposition meat would be a by-

¹ Motor power, whether derived from steam or from internal combustion engines, can be, and actually is, widely used on farms not only for the traction of cultivators and other moving implements, but also as a means of driving stationary machines such as threshers, chaff-cutters, slicing and pulping machines, pumps, and even milking machines and separators.

² This depends, of course, on the condition that motor power is cheaper than horse power, and this in its turn depends upon a lower relative cost per unit of work done, of mineral oil and its substitutes, than of oats and other feedstuffs for horses.

³ But compare the following quotation which bears on what follows:—"There are very few joint products the cost of production of which together is exactly the same as that of one of them alone. So long as any product of a business has a market value, it is almost sure to have devoted to it some special care and expense which would be diminished or dispensed with, if the demand for that product were to fall very much."—Marshall, *Principles*, Book V., VI., para. 5.

product without value in animal industries. It appears, therefore, that a certain quantity of meat is necessarily produced incidentally from the animals from which these indispensable articles are derived.

The question arises at this point as to how far the production of wool, leather, and hair (in the case of goats) has been sacrificed to the production of meat in the breeding of animals. In the course of the past two centuries this has been done in more ways than one.

In earlier times, in Europe, at any rate, live stock were probably more numerous in proportion to the population than now, but were inferior as judged by modern standards. However, such inferior stock were perhaps nearly as efficient on an average in the production of wool, leather, hair, etc., as the modern animal.¹ With the increase of population and the progress of civilisation, meat came to be in greater demand in proportion to supply than the materials under consideration were. This was especially the case when the growth of overseas commerce in the 18th century and subsequently enabled supplies of raw cotton to be brought to Europe. Since that time increasing supplies, not only of cotton, but also of hides and wool have been derived from distant sources. It should be noted that until the last quarter of the 19th century, when refrigerated transport was introduced, wool and hides were the leading animal products exported from the vast areas of pasture lands in North and South America and Australasia. European stock-raisers have accordingly aimed chiefly at meat or milk production and have given other considerations a diminishing share of attention. Cattle have been used less and less for working purposes. Great improvements have been made in the breeds of sheep, mainly for meat production; even during the last half century crossbreds have been increasingly substituted for pure wool sheep. Throughout the world animals are being constantly slaughtered for food at an earlier average age, cattle for veal and baby beef, and sheep for lamb. Moreover, the goat, which is mainly a skin and hair-producing animal, is becoming relegated more and more to the semi-arid tracts of the world unsuitable for agriculture or for rearing other animals, and incidentally its importance for food purposes among European populations is diminishing.

In another way, also, there has been a conscious change in the direction of meat production at the expense of the joint products above mentioned. Of all domestic animals the pig is most essentially a meat producer, being, in fact, the only animal that is bred exclusively for meat and meat products. During the last century

¹ As before noted, the number of animals alone is not a sufficient guide. In earlier times animals were kept longer so that the turnover was smaller in proportion. This would be favourable to wool production, but unfavourable to that of leather. During the last two centuries sheep have, on the whole, been bred more for meat and less for wool, which counteracts to some extent the gain in wool arising from the increased weight of the fleece in specialised wool sheep.

there has been a great increase in the proportion of pigs to other animals, notably in North America and Central Europe. This change is still in progress, as the pig is found to be the most efficient of meat producers under modern conditions, and fits in admirably with dairy farming, which, as has been observed, is increasing with the progress of more intensive methods. The tendency at present is rather towards the production of pig-meat and veal together with dairy products, than of beef and mutton. It is obvious that this tendency is directly opposed to the maximum production of wool and leather; the calf furnishes little, and the pig practically nothing except hair of small value, in the direction of subsidiary products, in the case of the latter owing to the custom of consuming pig-meat with the skin attached. The similar tendency above noted to substitute lamb for mutton in consumption has the effect of reducing the wool production in proportion to the flocks raised. The ousting of the sheep as a farm animal mainly as we have seen, by the pig, is a striking feature in the developments in animal industries during the last thirty years.¹

It appears, therefore, that the progress of animal breeding and rearing has resulted in a series of victories for meat production (and still more milk production) at the expense of other possible objects. It is true that an important fraction of the world's supplies of hides are derived from India and some other countries where cattle are still used largely for draught purposes, but these sources of leather-making material may diminish in importance with the increased use of modern agricultural machinery and with the progress of veterinary science, checking live-stock diseases and lengthening the working life of each animal. It is possible that the world may have to face in the near future a considerable, if not an acute shortage of wool, skins, and leather, especially since the displacement of horses will reduce appreciably one source of supply of hides, and since the Indian, Chinese and Japanese markets tend to absorb more wool and leather with the progress of westernisation. If substitutes are not easily found in sufficient quantities, the choice will then lie between breeding animals more for these products and less for meat (which would in some ways be a backward step in the intensification of farming), and increasing the flocks and herds of the existing breeds, thus aiming at meat production no less than at present. The latter is the more probable, since, as has

¹ The total number of sheep in the meat trade of the world at different dates have been estimated by Hooker as follows (in millions) :—

ABOUT 1880.	ABOUT 1890.	ABOUT 1900.	ABOUT 1908.
452·1	480·9	461·9	451·2

It will be seen that there has been a steady decline since about 1890, and that the total in 1908 was no greater than in 1880. The world's total of pigs, on the other hand, increased according to the estimates from 141 million in 1901 to 161 million in 1911, that is, by over 14% in ten years.

been shown, the demand for meat is likely to remain very keen, and the increased prices for wool and leather will stimulate all forms of sheep and cattle rearing.

III.

The bearing of an increase throughout the world in the dairying industry requires further detailed consideration in this connection. It has been shown above that such an increase is in progress and is likely to continue.¹ An expansion in dairying at the expense of meat-production, pure and simple, means that agricultural resources are being used more economically, since when the milk and the meat produced are reduced to a common denominator in food values, it is found that a given area of land under the same conditions of cultivation produces more human food in the shape of the former than of the latter.² To whatever extent the dairy industry dovetails better than pure meat-production into a system of mixed farming, by utilising labour more economically throughout the year and by yielding by-products that can be turned into other animal foodstuffs besides milk, it makes it possible to derive fuller advantage from the principle of incidental production. The high labour costs involved in dairying have in actual practice presented an obstacle to its more rapid expansion, although, as we have seen, the introduction of machinery is rapidly reducing this comparative disadvantage. Since any economies in the utilisation of agricultural resources tend to increase the residue available for the production of meat, an extension of dairying is, on the whole, favourable to the latter, though directly and at first sight unfavourable. It is to be observed, however, that milk tends to be regarded as more fixed than meat in the ordinary dietary, and that if population begins to press upon agricultural resources, milk production is apt to suffer less than meat production.³

The dairy industry, however, has in another way a directly favourable influence upon meat production. Reference has been made (see p. 189, above) to the fact that a certain amount of meat results as a by-product of the dairying industry in the form of cows discarded because of age, or because of unprofitableness. In practice dairying results in extensive meat production incidentally, since every cow is ultimately converted into beef; the only real differences between this form of meat production and the direct form are that the period of maturity is longer and the meat often of poorer quality. The progress of scientific dairying may furnish a greater proportionate supply of meat from this source.⁴ More-

¹ See Part II., Chap. ii.

² See (Cd. 8421), p. 27, also p. 211, above, Note 2

³ See U.S. Dept. Agric. Bureau of Crop Estimates, Rept. 109, p. 23.

⁴ The more scientific and intelligent become the methods of the dairy industry, the greater in all likelihood will be the proportion of cows annually turned over to slaughter, since unprofitable animals will be more rigorously discarded. According to the results of various investigations an appreciable

over, the average dairy cow produces generally one calf per annum. Now a small proportion—probably not more than a quarter—of all the calves produced is required to replace the discarded cows, though the more severe the process of discarding becomes, the greater will obviously be the proportion of calves raised for milch cows. In any case, by far the greater number are available for the production of veal or for rearing as stores for subsequent beef production. The number of calves that are destroyed as soon as they are born as being valueless is now small. In this way also the dairy industry furnishes a large potential supply of meat. The respective proportion of calves that are slaughtered while young for veal, and that are reared to maturity as beef cattle, depend mainly upon the agricultural resources available; if these are abundant a larger number will follow the latter course, if they are limited, as in some parts of Europe, a greater number will be consumed as veal. The extent to which calves of dairy cattle are raised for beef depends also, however, upon the suitability for beef production of the dairy breeds employed. It is significant in this connection to observe that the progress of scientific dairying tends to eliminate the dual-purpose animal (which naturally predominates in all newer countries) in favour of those breeds which produce a heavier milk-yield, but are inferior for beef production, sometimes to the extent of being almost unprofitable for the latter purpose. In this direction the progress of dairying is unfavourable to the incidental production of meat.

IV.

The existence throughout the temperate regions, of hill and mountain pastures suitable only for grazing purposes, has been noted above; it was pointed out that such pastures, being essentially adapted to meat production, would continue to produce certain limited quantities of meat as a by-product to the production of wool, skins and hides, even if the demand for meat were to fall to zero. Now certain rich pasture lands consisting of heavy soils, in the lowlands of some regions that have a wet oceanic type of climate, are on a somewhat similar footing in agricultural economy as hill and mountain pastures are. The lowland areas in question produce the best agricultural return when under pasture; they are difficult to work under cultivation and the climatic conditions are unfavourable to the harvesting of grain crops, while they are highly favourable to fodder crops and grasses. Examples are found in Western Europe, especially in Ireland, Western England, Holland and the North Western parts of France and Germany, and they occur in regions with a similar climatic situation, in other parts of the world. All such regions are naturally devoted to animal industries,

fraction of the average dairy herd does not return in milk even the value of the feedstuffs consumed. See U.S. Dept., Agri. Animal Industry Circular 103 (United States); U.S. Daily Commerce Report, Feb. 1st, 1912 (Canada); *Journal Bd. Agric.*, March, 1915 (England).

since the herbage they produce can appear as human foodstuffs only in the form of meat or milk. Granted that the production of animal foodstuffs is a less economical way of utilising agricultural resources in general for food production than is the cultivation of crops for direct human consumption, it may nevertheless be true that these regions are in practice capable of producing the maximum quantity of foodstuffs only in the indirect form of animal produce. The total area of land outside these regions devoted to permanent pastures is, of course, very great, and depends not only upon the demand for animal foodstuffs, but also upon the stage of agricultural development ; but even if the demand for animal foodstuffs were to fall to zero, some of the land in the above-named regions might not be taken for crop cultivation, but might remain as waste land so long as other more suitable agricultural land remained within reach of the world's transport system. It is clear that the existence of such areas, more or less removed from the probability of occupation for crop cultivation except of the fodder type, favours the continued existence of animal industries in the incidental form on some appreciable scale even under conditions of quite limited agricultural resources. It is clear also that rotation farming, in so far as it leads to the production of crops unsuitable for direct human consumption, brings about the same result ; however, if the demand for animal foodstuffs were to disappear, or if agricultural resources became very limited, no doubt root and fodder crops could and would be replaced by food crops to a considerable extent.

V.

In a preceding chapter notice was taken of the tendency towards substitution in consumption in the matter of foodstuffs and particularly of animal foodstuffs according to relative prices. It is now to be observed that since the aim of such substitution is to replace the more expensive article by a cheaper equivalent, its general result, so far as market prices correspond to the real costs of production, is to economise agricultural resources ; it often happens, in fact, that the principle of incidental production in relation to consumption can thus be taken fuller advantage of. In this connection certain special forms of substitution in consumption may now be examined in greater detail, with a view to noting their effects upon the economics of production. The causes that underlie changes in consumption contain a psychological as well as an economic factor. We have seen already that habit and custom give rise to marked friction to changes in this field ; so that these are made not without difficulty in response to altered conditions of purchasing power and of production ; but when once set on foot, they often gather force and thus react themselves upon the latter.

The displacement of animal fats in consumption which is now proceeding is a striking instance in point. The production of these articles is a costly process in terms of agricultural resources, and is

likely to be still more so in the near future. Animal fats rose considerably in price in the period 1903 to 1913, and are expected to rise further.¹ Consumers are, therefore, being driven to find such substitutes as exist. Butter, though an excellent substitute in itself, is out of the question because it is still more expensive; if price levels be taken as a guide, butter is more costly to produce in terms of agricultural resources than refined animal fats such as lard and oleo.² The great substitutes for animal fats are vegetable oils, consumed either as such, as, for example, olive oil and its substitutes, or in the manufactured forms of margarine and imitation lard. Indeed vegetable oils are not only being substituted for animal fats, but show a strong and a growing tendency to take the place of butter in the consumption of large sections of the population of Europe. The movement in both these directions obviously results in an economy of temperate agricultural resources. Further progress on these lines may cause a marked reduction to take place in the share of the world's agricultural resources devoted to the production of animal fats, and may, moreover, cause a greater proportion of the total milk output to be utilised in other ways than in making butter.

Other forms of substitution that may be noted here consist in the displacing of certain kinds of meat by others. Here, again, changes in the habits of consumption, originating in altered conditions of production tend to become more or less fixed and then to modify further the forms of production. It will be seen that such changes tend to follow the line of progress in production from less intensive to more intensive forms of animal husbandry. It has already been observed that the production of beef and mutton depends largely, though not altogether, upon the existence of pastures, while that of dairy products, veal, pig meat, and even of poultry and eggs is connected more particularly with the more intensive forms of agriculture in which fodder and feed crops are prominent and the charges for labour bear a relatively high proportion to the total costs of production. There has already been a marked decline in a number of countries in the per capita consumption of mutton,³ and a similar decline in beef consumption

¹ See Report of Committee on Edible Oil-producing Nuts and Seeds (Cd. 8248). para. 7.

² The wholesale price of butter on the London market prior to the year 1914 was more than double that of lard or oleo.

³ This is borne out by a study of the statistics of meat consumption in certain countries where figures are available for different years, as shown in table opposite.

The average exports of mutton, inclusive of live sheep, for the period 1902-4 from the nine principal surplus-producing countries were 494 million lbs., and the same for the years 1911-12 were 548 million lbs. These exports were sent almost entirely to Europe in which continent the table on p. 41. shows that sheep declined by 3 million in the period 1901-11. If each sheep produces on an average .2 cwt. of mutton annually, the equivalent decline in the production of mutton would be 67 million lbs, which is greater than the increase in the imports. Since the absolute supplies of mutton in Europe

would have arisen, had it not been for the recent rapid increase in the South American output.¹ Correspondingly there has been an increase in the per capita consumption of pig-meat in a number of countries.² In certain continental countries, where pastures are limited, the per capita consumption of veal has tended to rise, while throughout the European world the tendency prior to 1914 was towards an increased per capita consumption of poultry and eggs.

declined rather than increased in the period, the fall in the per capita supplies must have been serious. In North America the table, p. 41, shows that there was a marked decline in the actual numbers and a still greater decline in the per capita ratios of sheep in the period 1901-11. The disappearance in the interval of the export trade in live sheep to Europe cannot have been a sufficient compensating factor to maintain the per capita supplies of mutton at the same level.

	BEEF AND VEAL % OF TOTAL MEAT.	MUTTON AND LAMB % OF TOTAL MEAT.	FIG-MEAT % OF TOTAL MEAT.
UNITED KINGDOM :			
1890-1 to 1894-5	50	22.3	27.7
1900-1 to 1904-5	43	22.3	29.7
1905-6 to 1907-8	50.4	21.9	27.7
UNITED STATES :			
1900	49.1	4.2	46.7
1909	49.5	3.9	46.6
FRANCE :—			
1892	54.5	11.7	33.8
1904	54.4	11.4	34.2
GERMANY :—			
1904	35.9	2.1	62.
1913	34.5	1.7	63.8
CANADA :—			
1900	49.5	10.1	40.4
1910	44.5	6.5	49.

¹ The general decline in the ratios of all cattle to the population observed in Europe and North America has fallen rather upon mature beef cattle than upon dairy cattle, so that the former have declined all the more in proportion to the population. This decline is accounted for to some extent by the fact that young cattle have been slaughtered in increasing numbers for veal, instead of being fed to maturity.

Enumerations are not an exact guide to meat production. It is clear that if an animal is slaughtered at the age of 1 year instead of at the age of 2 years, it escapes one enumeration as compared with the latter case, but the meat produced is not twice as great at the end of two years as at the end of 1 year. If, however, a calf is slaughtered for veal within one year of birth, it may escape all enumerations. The slaughtering of animals at an earlier age tends therefore to reduce the figures of enumeration without always a corresponding decline in meat production arising.

² The United Kingdom is again an exception. In the import trade between 1901 and 1913 pig-meat declined per capita, while mutton and lamb rose.

These changes are in keeping with, and are probably in no small measure a consequence of, the conditions of economy in production.¹ The pig is the most economical converter among meat-producing animals, and is adapted to the more intensive form of farming since it requires mainly concentrated feedstuffs. A certain amount of friction is to be observed in the substitution of pig-meat for beef and mutton in consumption, owing to the traditional place of importance occupied by the two latter in the dietary of certain European populations. This, however, would tend to disappear under the pressure of a meat shortage, more especially so, if, as may be anticipated, prime steer beef is available in smaller quantities in the future. Some friction appears also in this matter, owing to the prejudice among certain people against the consumption of pig-meat, in some cases in any form, and in others, except in the form of bacon and ham; but the pressure of a meat shortage would tend to overcome this likewise, and the steady improvements in the methods of rearing pigs and the more general enforcement of sanitary inspection, work in the same direction. With regard to veal there exists no popular prejudice against its consumption; on the contrary, it is regarded somewhat in the nature of a delicacy. We have seen already that in the absence of extensive pasture lands, veal is a natural by-product of the dairy industry, being more economically produced than prime beef.² With the probable extension of that industry in the future the quantities of veal available for consumption would be increased. If, moreover, cheese and whole milk are more widely consumed in the future as the most economical means of converting into human food the grass fodders and feedstuffs suitable for cattle and sheep, not only would the resources in these materials available for the rearing of calves to the beef-producing age be reduced, but the need for the present proportion of beef and mutton in the dietary would no longer be felt so keenly. As some set-off, however, the quantities of veal available for consumption would be considerably increased. It is to

¹ The table showing the efficiency of different animals as converters of feedstuffs into foodstuffs is worth quoting in this connection (Cd. 8421, p. 27). The figures represent the number of lbs. of starch equivalent in feedstuffs required to produce 1,000 calories in the form of the named animal foodstuffs.

Milk from a good cow, 2·9; pig-meat, 3·0; veal, 4·7; milk from a bad cow, 4·7; mutton, 5·3; eggs, 7·0; baby beef, 7·0; steer beef, 9·0.

² A so-called Law of Diminishing Returns has been formulated with reference to the productive capacity of cattle according to age; the following table shows the number of lbs. of dry matter in the form of feedstuffs required for 1 lb. gain in live weight:—

Calves, 3 weeks old	1 to 1½ lbs.
„ 7-97 days old	1·97 lbs.
„ during first 8 months	4·6 lbs.
„ during first 17 months	5·97 lbs.
Cattle, 2 years old	7·19 lbs.
„ 32 months old	10·4 lbs.

U.S. Dept. Agric., *Farmers' Bulletin*, No. 71.

See also Wood, *National Food Supply*, pp. 36-7.

be observed that when the general system of farming passes from the predominant pastoral to the more intensive forms, the labour and feed materials employed produce a greater proportionate return in human food when devoted to the production of pig-meat, dairy products with veal, and poultry and eggs, than when devoted to the production of beef and mutton. The latter is economical only when land is sufficiently abundant to admit of extensive areas of pasture; then the cattle and sheep can largely look after themselves, and the charges for labour are small. Under the more intensive forms of farming in which the rearing of animals depends to a much greater extent upon arable for the production of fodders and concentrated feedstuffs, and in which hand or stall-feeding consequently replaces grazing largely, the labour and feed materials are much more economically utilised in the other ways mentioned.

The consumption of poultry products appears to be very elastic at reasonable prices; practically no friction to expansion arises through the adverse taste or prejudice of consumers. From the figures already quoted (p. 268, Note), it appears that poultry are economical converters of feedstuffs, and considerable developments in poultry-rearing are to be expected, as has been noted, in the future. Even in the absence of a meat shortage, the pressure of consumption would favour the increased production of poultry products.¹

A word requires to be said at this stage concerning the consumption of mutton and lamb as compared with that of beef, in its bearing upon production. Among the people of the British Isles and of Australasia mutton and lamb have become established as traditional articles of diet almost on the same level as beef; elsewhere, however, among meat-consumers mutton and lamb are of small importance and tend to decline further in per capita consumption. No doubt mutton and lamb are welcomed as a change from beef in the dietary, but pig-meat, poultry and eggs, cheese and veal are perhaps equally capable of furnishing the required alternatives for a varied diet; indeed they are so used much more widely on the continent of Europe and in North America than in the British Isles and Australasia, where the geographical conditions and the cheapness of mutton have contributed to its position of traditional importance in consumption. On the whole, as has been shown, sheep are losing ground throughout the world, and if it were not for the important joint-product of wool, would be much less prominent as meat-producers than at present. It is the demand for wool rather than that for mutton and lamb that maintains sheep-farming. Under the more intensive methods of agriculture, it is doubtful whether sheep will prove to be as economical even as beef cattle in meat production. Thus in carrying capacity natural pasture lands are estimated to maintain four sheep to one head of cattle, while in meat production per annum the ratio is apparently from 5 to 6 sheep to one head of cattle.

¹ See Part II., Chap. ii., pp. 214-220.

The weakness of the sheep as a meat-producer lies in the high proportion of breeding ewes necessary ; a sheep slaughtered at the age of 12 months appears to be a fairly economical meat-producer ;¹ but while breeding ewes, as such, produce only wool, the dairy cows from which a large proportion of the beef stock are derived, produce considerable quantities of milk. From the point of view of farm accounting also, if the wool produced by sheep is reckoned as a credit item together with its meat, then the difference in value between the hides of beef-cattle and sheep skins should be similarly treated. Nevertheless in considering the future of the sheep in meat production, it must be noted that there are, and always will be, vast areas in the continents outside Europe, where for geographical and other reasons, sheep can be more economically raised than any other animals ; from these regions the world in the future will be driven, in the absence of a rapid increase in agricultural resources relative to population, to derive an increasing proportion of its wool and mutton supplies. Wherever agriculture becomes intensive, as it tends to do in Europe and parts of North America, sheep have not only declined, but seem destined to disappear still further in favour of more economical food-producing animals, among which cattle, taken as a whole, must be included. Only a very keen demand for wool could strengthen their position there ; the demand for fresh mutton and lamb will hardly be effective, because prices would soon cause consumers to turn, as is desirable, to the substitutes. In Great Britain, however, where sheep are reared on a more or less intensive system by fattening on root and fodder crops, they have declined little in absolute numbers in recent years, though considerably relative to the population. The similar semi-intensive system of rearing sheep in New Zealand, the greatest of mutton and lamb exporting countries, has already been noted (Part I., Chap. iv.). If the more intensive methods of mutton production can be developed further—but only on this condition—sheep may be able to hold their own to a limited extent in regions suited to the rearing of cattle and other meat-producing animals. The development of more intensive methods in sheep-rearing would, of course, be assisted by any improvements in breeding which should lead to the evolution of a type superior to those existing, in combined wool and mutton producing capacity. As it is, the only marked advantages that sheep show in meat-production, as compared with competing animals, are that they can be fattened with less concentrated feedstuffs ; that they can subsist upon rough hill and mountain pastures unsuitable for cattle ; and that the labour charges in tending and feeding them are comparatively light.

On the whole, notwithstanding the fact that changes in the forms of consumption of foodstuffs on the part of any given population in the mass are liable to friction owing to peculiar tastes and pre-

¹ T. B. Wood, *The National Food Supply in Peace and War*, p. 32,

ferences, to prejudice and to the force of fixed habits, it will be seen that the demand of consumers for the less costly supplies of concentrated foodstuffs, tend to favour changes in production from the extensive to the intensive forms of agriculture and animal husbandry, that is, from single-purpose to incidental production ; it will favour the production of milk rather than beef, of cheese rather than butter, of veal rather than steer-beef, of pig-meat and poultry and eggs rather than mutton or than beef except from discarded dairy cows ; on the production side, therefore, it will favour specialisation in the smaller animals, sheep excepted. The demand for cheap nourishment and the economies of production react upon each other, so that neither is wholly the cause of the other. The psychology of consumption is a subject that opens up problems in relation to production which remain to be investigated. We may close this section by drawing attention to one possible reaction under this head : if a much smaller proportion of the milk produced by dairy cattle were to be used for making butter than at present, and the proportion of prime pig-meat in the total supplies of that article became thereby reduced, to what extent would the present growing demand for pig-meat be checked among consumers throughout the world ?

VI.

In addition to favouring economies in production any noticeable shortage of animal foodstuffs in relation to effective demand would in a positive way stimulate the whole agricultural industry. More capital and labour, so far as they are available, would be employed in the production of foodstuffs in the occupied regions and the development of the outlying parts of the temperate regions, and of the tropical highlands would be hastened. The demand for animal foodstuffs is likely, in fact, to be keen in relation to the supplies available in the near future unless the purchasing power of consumers suffers appreciable decline, and greater attention is therefore likely to be given to certain special developments that favour the maximum output. Public interest in the methods of agricultural production has been wanting in a number of countries during the last two or three decades owing to the apparent abundance of foodstuffs, but any shortage of animal foodstuffs will tend to arouse public interest and cause State action to be directed to the control of the methods employed, and may even cause a greater proportion of the better brains in each country to be devoted to agriculture and to the problems of agricultural production. Already steps have been taken by the American Government towards the control and the restoration of the Western Range pastures, for which a constructive policy has been outlined.¹ Similar advances are likely to be made in the future in other countries where pro-

¹ For fuller information concerning the Range Lands of the United States with reference to their stock-carrying capacity, see the following publications of U.S. Dept. of Agriculture : *Yearbook of Agriculture*, 1914, pp. 15-17 and 65-88 ; *Bulletins*, 367 and 34 ; *Bureau of Crop Estimates*, Report 110.

ductive lands have been misused or are not utilised to their full capacity. Public expenditure on transport and storage facilities, which has increased rapidly in recent years, comes under the same head. Unfortunately, however, while the market for foodstuffs is international, public control of the means and methods of agricultural production is limited to the territories of individual states, so that the surplus-producing countries may lag behind in this matter until the pressure of population or market conditions induce them to take State action. In the field of animal industries some of the most pressing problems lie in the control and eradication of animal diseases, which cause enormous havoc among livestock, especially in the newer countries.¹ Some efforts have been made to seek the causes of these diseases and to check the destruction worked by them, but except in Western Europe, the results have been comparatively small, and much remains to be done in this department of veterinary science. This is essentially a matter for State action in the various countries concerned, and public attention is likely to be directed to it, especially if stimulated by a shortage of animal foodstuffs. If epidemics of animal diseases could be more or less completely mastered, not only would there be a marked increase in the meat production of the existing flocks and herds, but animal rearing could be successfully carried into vast regions of warmer climate, that at present produce little or nothing of food value to mankind.²

So far as any positive extensions in the effective agricultural resources are produced directly or indirectly in these or in any other ways, to that extent the residue available for the production of animal foodstuffs tends to be increased. These developments work hand in hand with the principle of incidental production and in the broadest sense constitute an extension of that principle.

Animal industries are so thoroughly established in the general systems of agriculture in regions populated by Europeans that there is little likelihood of their being largely displaced. Similarly animal foodstuffs in one form or another are regarded as a necessity in the diet of most white populations, and nothing but a very great decline in agricultural resources relative to the population to be maintained, would be sufficient to cause these populations to do without them to any great extent. We have seen that even under these conditions various circumstances would cause animal

¹ Some indication of the great losses from this source in the United States alone is given by the following figures (U.S. Dept. of Agric. Report, 109, p. 141) :—The annual losses by disease of cattle since 1900 have ranged from 1.1 to 1.475 millions; of sheep since 1889 from .8 to 1.8 millions; of pigs since 1884 from 2.0 to 7.0 millions. It may be presumed that the losses in other newly settled areas are in proportion.

² The largest areas in this class exist in North and South America (including Central America) from the lower Mississippi Valley to Northern Argentina. Similar regions occur in sub-tropical South Africa and in Northern Australia. See Part I., Chap. v.

foodstuffs to be produced incidentally and to a limited extent without interfering with the production of plant foodstuffs for human consumption. Not only, however, are animal foodstuffs regarded as an essential part of the diet of European peoples, but the average per capita consumption of them tends to increase under favourable conditions, that is, when sufficient supplies are available at prices within the means of consumers. The factors that are potentially effective in bringing about these favourable conditions fall mainly under the head of production, but partly under that of consumption.

In consumption some saving can be indirectly effected by the substitution within certain limits of some animal foodstuffs that can be more economically produced, for others that are less so; waste can be considerably reduced, and the losses due to bad handling and storage largely avoided. Such developments are more likely to make progress during a time of shortage such as is to be anticipated in the near future; but the changes, when once established, are likely to become more or less permanent, even if the shortage disappears subsequently. Their real effect is to bring about a better utilisation of the resources and supplies available, and thereby to increase the consumption in terms of food values beyond what it would otherwise be. In another direction consumption tends to increase with any rise in the purchasing power of industrial populations. Here, however, the increase is liable to be checked by the rise in the price per unit, since the production of animal foodstuffs is not very elastic in short periods. A permanent improvement in the economic position of the industrial classes, due, for example, to a great rise in the level of real wages, would stimulate the whole industry of agriculture and animal industries in particular, under the influence of the higher prices which consumers would be able to pay.

However, the key to the whole situation lies in the conditions and the methods of production, not only in animal industries themselves, but also in the whole field of agriculture. Some attempt has been made in this enquiry to indicate in what directions the problems relating to these matters lie.

SUMMARY OF CONCLUSIONS—PARTS I. AND II.

The study of the questions relating to the production and the consumption of animal foodstuffs made in this enquiry has led to certain conclusions which for convenience may be summarised here.

A stage has now been reached in the general economic situation, in which the supplies of animal foodstuffs distinctly tend to fall short of normal requirements throughout the world-market (I., 3). This is due to three causes that work together to produce the same result; the first is that owing to the comparative lack of undeveloped fertile regions, the rate of expansion in the surplus production of pasture-fed meat animals and of concentrated feedstuffs from the newer overseas countries is slowing down (I., 3 and 4); the second that the white meat-consuming population of the world has been increasing rapidly and still tends to do so (II., 1); the third that with the general improvements in the financial status of industrial and agricultural workers in Europe, their per capita consumption of animal foodstuffs taken as a whole, tends to rise, a feature that becomes all the more marked when the birth-rate falls (II., 4).

With regard to the supplies of animal foodstuffs derived from the surplus-producing regions (I., 4), those from North America declined remarkably in the period 1900-13, while those from South America rose, but not to the same extent as the former declined (p. 141); the change in both cases was most conspicuous in beef. Supplies from other surplus-producing regions expanded at a moderate rate only. The outlook for the immediate future does not disclose any likelihood of a great increase in supplies except at much higher prices. North America has increased its net surplus during the war period, but may in the future become a deficiency area in the matter of certain animal foodstuffs; and owing to the war and to political disturbances, the enormous surplus of animal foodstuffs and feedstuffs from Russia and Siberia has temporarily disappeared, and this export trade may not recover for some time to come. As regards the limitations imposed by geographical conditions upon the production of animal foodstuffs, the situation may in the future be relieved to some extent by the development of the pastoral resources of the tropical highlands and by an increased output of oleaginous seeds and nuts from the tropical and sub-tropical lowlands (I., 5).

The supplies of concentrated feedstuffs are of the greatest importance as determining the output of animal foodstuffs in the regions of more intensive agriculture in Western Europe (I., 2). A number of countries showing a comparatively large surplus of these foodstuffs, referred to in this enquiry as the elaborating-commercial

group, depend largely upon imported supplies of these materials for the maintenance of their surplus (I., 2 and 6). The same is true of the deficient industrial countries with regard to the supplies of animal foodstuffs that they produce within their borders (I., 7). In strict accuracy the exports of concentrated feedstuffs should be credited together with those of animal foodstuffs to the surplus-producing countries and the imports similarly debited to the importing countries (I., 2, Table, p. 34.).

The costs of production of animal foodstuffs tend at the present time to increase, because the necessity of using land more intensively involves greater outlays for capital and labour, and because land values are rising (I., 12). This feature will remain so long as the increasing demand of consumers makes it necessary to extend or deepen the process of intensification ; unless, in the meantime, the progress of technical science and the establishment of the whole agricultural industry on a new basis greatly increases the output in proportion to the expenses.

The introduction of labour-saving machinery, which has led to marked economies in the production of crops, has not hitherto been of any great benefit in the production of animal foodstuffs except indirectly (I., 10).

When agricultural resources are limited as they appear to be now in relation to the population to be nourished, the production of food crops has a prior claim to that of animal foodstuffs for the use of land, and animal industries tend therefore to be residual in agriculture (I., 12, and II., 2). However, animal industries are in some measure incidental (and to that extent tend to persist), owing (*a*) to the complex nature of mixed farming ; (*b*) to difference in soil, climate and accessibility among agricultural regions ; (*c*) to the demand for joint products such as wool and leather, and (*d*) to the tendency to soil exhaustion when land is used exclusively in successive years for the production of food and industrial crops (II., 5). The incidental production of animal foodstuffs can be increased by certain modifications in consumption without necessarily reducing the standard of diet, particularly by effecting a reduction of the proportions of prime beef and of mutton in the total quantities of animal foodstuffs consumed (II., 5). Owing to their residual status in agriculture, animal industries are open to competition for the use of land from the requirements of food crops such as wheat, rye, sugar beet, and potatoes, and of certain raw materials such as cotton, flax, linseed oil and even timber (I., 11).

The total agricultural output of the world, and therefore the residue available for the production of animal foodstuffs, is susceptible of great increases in the future, apart from the gains likely to arise from a more effective utilisation of the resources of regions in the tropical zone ; the quantities of mineral fertilisers available in the future are likely to expand rapidly (I., 8), and this factor, though it will reduce on the whole the incidental nature of animal

industries as the readiest means of preventing rapid soil exhaustion, will favour them so far as it increases the residue of agricultural production above that required in the forms of food and industrial crops; constant progress is being made in improving the types of domesticated animals and the species of cultivated plants; plant and animal pests and diseases are being slowly overcome; horses are being replaced by motor-power for agricultural operations (II., 5); transport facilities are being extended in the more remote parts of the temperate regions; and fertile agricultural land within easy reach of markets can, as experience has proved, be made much more productive than has hitherto been the general rule, but here difficulties arise through the shortage of capital and skilled labour available (I., 9), through the lack of suitable social organisation, and through insufficient technical training among farmers (I., 12).

The whole of the processes by which the average agricultural output per acre may be increased can be summed up in the single word, intensification. Although rapid progress in this direction is theoretically possible, actual progress is slow owing to a variety of causes, the most prominent among which is the general conservatism and lack of enterprise among producers, due in no small measure at the present time to the insecurity of market prices in the period between 1875 and about the year 1905.

The anticipated shortage of animal foodstuffs in the near future can be met by action on the part of consumers, so that the impairment to the standard of living that might arise as a consequence may be lessened.

Fish will probably be available in much greater quantities than hitherto as a substitute for meat (II., 2). Certain plant foodstuffs, notably vegetable oils, can, if properly prepared, be used as efficient substitutes for animal foodstuffs (II., 2 and 3); dairy produce can be used more widely to replace meat and animal fats, and the consumption of those products that contain a larger proportion of the nourishing elements in milk than does butter, can be extended (II., 2); pig-meat can be economically used to replace in some measure both beef and mutton (II., 5); waste in many of its forms can be reduced (II., 4); and the effectiveness of the supplies available to a given population can be increased by securing a more equal distribution between the different social classes (II., 4). Some of these changes, if adopted, may become more or less permanent with favourable results.

The duration of the future shortage is uncertain owing to the impossibility of forecasting the working of the various determining factors, whether favourable or unfavourable to increased supplies relative to effective demand. If European populations are much poorer at the close of the present war, the effective demand may fall as compared with the pre-war level, and in this case the need for increased supplies would disappear, temporarily at any rate. The premiss adopted in this enquiry, however, is that demand will

expand at least in proportion to the increases in the consuming population. On the whole, it is desirable that it should, so that the standard of living may be upward rather than downward. Under these circumstances it appears that if the favourable factors are brought into early operation and no unforeseen unfavourable factors arise, the shortage of animal foodstuffs may be of short duration: it may indeed be followed within a decade or so by a period of comparative abundance of animal foodstuffs for the consuming populations of the world.

PART III.

THE PRODUCTION AND CONSUMPTION OF ANIMAL FOODSTUFFS IN THE BRITISH EMPIRE.

CHAPTER I.

SURVEY OF PRODUCTION AND CONSUMPTION WITHIN THE EMPIRE.

IT is proposed to deal in these chapters with the questions relating to the production and the supplies of animal foodstuffs within the Empire. We shall find in the course of the enquiry that the British Empire, as a whole, is a deficiency area, and an endeavour will be made to point out, as occasion arises, in which particular ways the deficiency appears and what are the underlying causes. It is obvious that, in the words of a prominent witness before the Dominions Royal Commission in London, "the more dependent England becomes upon imported meat, the more easy it is to be controlled from outside." This refers particularly to sources of supply outside the Empire, and the ideal (as yet far from realised) is to render the Empire, as a whole, as much self-contained as possible in its supplies of animal foodstuffs,¹ even though importations of animal feedstuffs in considerable quantities are almost inevitable for some time to come.

Examination shows that the production and the consumption of animal foodstuffs within the Empire are both confined mainly to the British Isles and the self-governing Dominions, that is, to those parts inhabited by white people. The Crown Colonies and the Protectorates, lying as they do, largely within the tropics, do not call for consideration except as regards their actual or potential production of feedstuff materials.

Taken together, the United Kingdom and the Dominions have enormous pastoral resources. Nevertheless the production of animal foodstuffs within the Empire is by no means equal to the consumption, as is shown by the following table of the net imports of such articles into the United Kingdom from the rest of the Empire and from foreign sources for the average of the three years 1911-13.²

¹ Compare the following conclusion set forth by the Dominions Commission in their Fifth Int. Report (Cd. 8457), p. 43: "In our view the problem of protecting and augmenting its meat supplies will be one of the most serious which the Empire will have to face in the near future."

² The table has been compiled from material found in tables published by the Dominions Commission (Cd. 8123).

The imports of animal foodstuffs into the United Kingdom from foreign countries represent fairly closely the Empire's deficiency, the exports from the Dominions to foreign countries are small, and the imports equally small, so that one offsets the other.

Articles.	Total net imports ¹ mill. cwt.	From Empire mill. cwt. ²	From foreign sources mill. cwt.
Beef, live cattle	·57	·13	·44
Beef, dead meat ...	8·2	1·27	6·93
Mutton, live sheep	·01	·002	·008
Mutton, dead meat	5·2	3·47	1·73
Pig-meat	6·17	·5	5·67
Salted and preserved meat	·84	·355	·485
Butter	4·03	·965	3·065
Cheese	2·256	1·877	·379
Condensed Milk	·712	—	·712
Margarine, etc. ³	1·405	·07	1·335
Lard	1·63	·1	1·53
Tallow	1·07	·68	·39
Eggs	2·66	·001	2·659
Poultry	£ mill. ·815	£ mill. ·001	·814

A study of this table shows that among the various items detailed, only mutton and lamb, cheese, and tallow are supplied from the Empire to the extent of more than half of the total imports into the United Kingdom; while practically the whole of the condensed milk, margarine, eggs, lard and poultry imported are derived from foreign sources. In production as related to consumption, the weakness of the British Empire occurs in poultry produce, pig-meat and lard, beef and dairy produce in the order named. It will be noticed that the production of all of these, except perhaps of beef, depends upon the more intensive methods of animal husbandry and the conclusion suggests itself that the British Empire as a whole is backward compared with other areas in respect of intensive methods of production. This conclusion is confirmed by the further observation that the Empire's chief strength lies in the production of mutton and tallow which are more particularly products of a pastoral industry involving a minimum expenditure of human labour. The per capita consumption of mutton and lamb among the white people of the British Empire is higher than that of any other considerable population in the world; and they thus appear to depend, so far as their meat supplies are concerned, more largely upon the produce of the purely pastoral industry than

¹ Net imports are the quantities retained for consumption, *i.e.*, total imports less re-exports and exports of United Kingdom produce.

² Except where re-exports are negligible, the figures in this column have been obtained by multiplying by the factor, $\frac{\text{net imports}}{\text{total imports}}$.

³ Includes margarine, oleomargarine and imitation lard.

do the people of other parts of the world. This statement, however, is subject to some qualification, owing to the fact that the beef and mutton produced in the United Kingdom, which forms an important part of the total meat consumption of the Empire, is not raised by any means entirely upon pastures.

These conditions are due to the fact that, whereas the Dominions are unsuited to intensive animal industries, owing to their undeveloped state and their small production of concentrated feedstuffs, the United Kingdom, which is geographically and climatically well suited to such industries with the assistance of imported feedstuffs, has made comparatively small use of its resources in this direction. In any case, the great weakness of the British Empire, so far as concerns the production of animal foodstuffs, arises from its deficiency in concentrated feedstuffs, and in fodder crops such as alfalfa, which are essential for fattening purposes. From this arises its striking deficiency in pig-meat and lard, in poultry products, and to some extent also in beef and dairy products. The first two of these depend for their production, absolutely upon abundant supplies of cereal feedstuffs, while that of the third and fourth is possible only on a limited scale, except in regions of specially favourable climate, without the employment of concentrated feedstuffs for winter feeding and for fattening.

The position of the British Empire with regard to feedstuffs is shown in the table below, in which the first two columns give the average imports of the various cereals and feedstuffs into the United Kingdom in 1911-13 from foreign countries and from Empire sources respectively, and the last two columns give the quantities estimated to be available for feedstuffs, separated into the same two divisions as regards origin. The figures have been compiled from those given in (Cd. 8123) and net imports have been taken proportionately wherever the re-exports were appreciable.

From the total of approximately 76½ million cwt. of feedstuffs for food animals imported into the United Kingdom from foreign countries it is necessary to deduct the exports of milling offals, amounting to about 5 million cwt., thus leaving a total of 71½ million cwt. This, however, does not accurately represent the deficiency of the Empire in feedstuffs, owing to the net exports of wheat from overseas parts to foreign countries which have been estimated at about 49 million cwt. annually¹ and would contain an equivalent in feedstuffs of about 16 million cwts. The other items of imports and exports of feedstuffs, or of feedstuff equivalents, from the Empire to foreign countries and *vice versa* may be taken as roughly balancing one another,² The net annual deficiency of

¹ Dominions Commission, Final Report (Cd. 8462), p. 186.

² Among the exports of such materials not accounted for are the net exports of grains other than wheat from Canada, and of oil seeds and nuts from India to foreign countries; against these, however, the considerable net imports of maize into Canada have to be reckoned.

the British Empire, therefore, in feedstuffs for food animals in the years 1911-13 was approximately 56 million cwt.

	Total net Imports.		Estimated quantities available for food animals. ¹	
	From foreign sources.	From Empire.	From foreign sources.	From Empire.
	mill. cwt.	mill. cwt.	mill. cwt.	mill. cwt.
Maize.....	41·96	2·03	33·57	1·62
Oats	15·6	2·23	1·56	·22
Barley	16·8	5·26	8·4	2·63
Wheat	50·7	53·	16·9	17·66
Cotton-seed	8·3	3·98	4·15	1·99
Linseed	3·38	4·59	1·69	2·295
Rape Seed	·51	·39	·255	·195
Oil-bearing Nuts and Kernels ...	·18	·98	·09	·49
Cotton Cake.....	4·66	·12	4·66	·12
Linseed Cake	·04	·02	·04	·02
Miscellaneous Oil-seeds	·61	·14	·30	·07
Soya Beans ...	3·34	—	1·67	—
Peas and Beans	1·81	1·46	1·36	1·11
Grain Offals (gross) ²	1·74	2·49	1·74	2·49
Totals			76·385	30·91

The first fact that strikes the attention on a study of the above table is the enormous extent of the imports of feedstuffs into the United Kingdom, representing a net total of over 5 million tons of materials available for food-producing animals, of which only about 29% was derived from other parts of the Empire. Examination of the separate items shows that the deficiency in maize is much the most striking, not only as regards the total quantity imported, but also as regards the proportion (over 95%) derived from foreign sources. Moreover, from the Imperial point of view, the Canadian deficiency in maize³ must also be taken into consideration. Unfortunately there is not much likelihood that this dependence upon foreign sources of supply will be greatly lessened

¹ The following conversion co-efficients have been taken; for maize, peas and beans, $\frac{4}{5}$; for oats, $\frac{1}{10}$; for barley and all oil-bearing nuts and seeds, $\frac{1}{2}$; for wheat, $\frac{1}{3}$; and for cakes, meals and corn offals unity. See Part I., Chap. xi., and Wood, National Food Supply, p. 17.

² Includes rice offals as well as others.

³ This deficiency has amounted in recent years on an average to over 5 million cwt.

in the future, since no part of the Overseas Empire has hitherto developed as an important surplus maize-producing area.¹ With regard to the other items in the table, it will be seen that only in tropical oil-seeds is the proportion derived from Imperial sources a really heavy one. This item, in the years preceding the war was relatively insignificant, but it has since increased very greatly in importance and may do so still further in the future, if the export trade from West Africa and from the Indian Ocean to the United Kingdom is developed to its full capacity. A very large increase in this trade might indirectly lessen the dependence of the United Kingdom and of the Empire upon foreign countries for supplies of cotton and linseed cakes and even of maize.

In only three other items, namely, linseed, wheat and grain offals among the feedstuff materials imported into the United Kingdom, was the share supplied by the Empire more than half. Considering that over one-half the total direct and indirect imports of milling offals came from Imperial sources, and allowing for the exports of such materials from the United Kingdom and for the exports of wheat from the Empire to foreign countries, it is found that the Empire's consumption of milling offals was in reality perhaps completely covered by its production of the same in the form of wheat and other food grains. If wheat cultivation within the Empire expands at the same rate as it has done in recent years², there may even be a virtual surplus of this class of feedstuffs. On the other hand, it must be remembered that the Empire as a whole shows a marked deficiency not only in animal feedstuffs taken together, but also in animal foodstuffs. If a real endeavour is made in the future to meet these deficiencies from Imperial production, the whole of the milling offals produced within the Empire would require to be retained as animal feedstuffs. In view of the great deficiency of the United Kingdom in both animal foodstuffs and feedstuffs, it is remarkable that there should have been extensive exports of milling offals from British ports in the years preceding the war.

With regard to the remaining items in the table above, it will be seen that in 1913 only comparatively small proportions of the deficiency of the United Kingdom in oats and in barley were sup-

¹ The Union of South Africa, however, shows some promise as a surplus maize-producing area. The exports of maize thence rose from 11,000 tons in 1913 to 149,400 tons in 1915. Large tracts of land in various parts of the Union and in Rhodesia are said to be adapted to maize cultivation, but expansion awaits closer settlement and better means of transport.

² In the period 1901 to 1911 the wheat acreage of the Empire increased 45.5%, while the population increased only 6.8* (Rex (Cd. 7271), p. 377). The increase in production was probably greater than the increase in acreage owing to higher average yields. Since 1911 there has been a considerable increase in wheat production in Canada and in Australia, and it seems probable that in the near future there will be an appreciable increase in the wheat production of the United Kingdom.

* The white population of the Empire increased by about 14½% in the same period.

plied from the overseas Empire. Now extensive areas in the temperate regions of the Empire are admirably adapted to the cultivation of one or other, or of both of these crops. Both succeed well in the United Kingdom, for example. The extensive imports of these cereals into this country from foreign sources, prior to 1914, may be accounted for mainly through the large and cheap surplus from Russia.¹ Even when peace conditions are restored, however, it may be some considerable time before the Russian export trade in cereals reaches its previous dimensions, and in any case, it may not resume its old channels by any means completely owing to the surplus being partly or largely intercepted by countries nearer to Russia than the United Kingdom. This would scarcely be a matter for regret, since there is no essential reason, beyond the difficulties and costs of transport, why the United Kingdom, together with the outlying temperate parts of the Empire should not entirely supply the Empire's requirements in oats and barley. It may be observed, incidentally, that Russia was formerly an important source of wheat supplies also for the United Kingdom, and that wheat exports from Russia are likely to be affected in the same way as those of oats and barley in the future. Hence the British Empire's production of all three of these grains would be stimulated by any failure on the part of the Russian export trade to the United Kingdom to resume its former proportions.

The Empire's position with reference to feedstuffs may now be summarised in general terms. It will be seen later that in the case of bulky commodities such as food cereals and feedstuffs, the imports into the United Kingdom from foreign countries, that is, the apparent trade deficiency, will always tend to be greater than the net deficiency of the Empire. In fact, in some of these items the United Kingdom may have an import trade from extra-Imperial sources, while the Empire, as a whole, may become a surplus-producing area. This fact must always be borne in mind in considering the relations between production and consumption within the Empire in these products. Thus, in the feedstuffs derived from wheat and to a smaller extent in those derived from oats and barley, the Empire's net deficiency was already in 1913 less than that shown by the imports into the United Kingdom from foreign countries. Nevertheless, the Empire as a whole showed a net deficiency in all these items, which, however, may be remedied more or less completely in the future. The oil-seeds group is very important from the point of view of the Imperial production of feedstuffs. Under this head there is at present a considerable deficiency when cotton-seed and cotton-seed cake are included, but

¹ The export trade in barley and oats from the Russian Baltic ports to the United Kingdom was assisted by cheap freights. In the period 1909-13 Russia supplied 33% of the total imports of barley into the United Kingdom and 32% of those of oats. It should be noted that there were appreciable quantities of these cereals exported from Canada to places outside the Empire at the same time.

the Empire is a considerable producer not only of tropical oil-seeds, but also of linseed and cotton-seed. It is obvious that much depends here upon the establishment of more extensive crushing and extracting works in the United Kingdom, otherwise Empire-grown oil-seeds may find their way, as in the past, to foreign countries. It is upon increased quantities of feed-cakes and meals derived from Empire-grown oil-seeds treated in the United Kingdom, that the chief hopes are to be placed for reducing the Empire's present great deficiency in animal feedstuffs. This deficiency as we have seen, appears at present most conspicuously in maize, and as but small quantities of this cereal are at present produced within the Empire, the only immediate means of reducing the dependence in this direction upon foreign sources of supply is to use Empire-grown substitutes to the fullest possible extent.

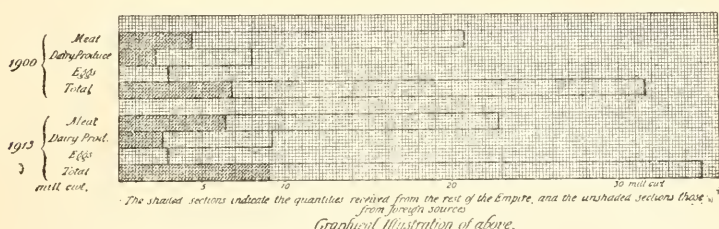
We may now pass on to a more detailed examination of the Empire's position with regard to animal foodstuffs. The table below shows the total quantities of these articles imported into the United Kingdom in the years 1900 and 1913, summarised in the

	1900			1913		
	TOTAL.	FROM EMPIRE	%	TOTAL	FROM EMPIRE	%
Cattle {No. ...	495,645	106,665		14,743	4,650	
{Wt. ¹	3,095,281	666,656		92,144	29,062	
Sheep {No. ...	382,833	35,673		—	—	
{Wt. ¹	191,416	17,836		—	—	
Dead Meat	17,438,756	3,759,126		22,756,652	6,294,267	
Total Meat	20,725,453	4,443,618	21.4	22,848,796	6,323,329	27.7
Butter	3,378,516	656,580		4,139,028	847,997	
Margarine, etc. ...	920,412	84		1,518,297	48	
Cheese	2,705,878	1,593,042		2,297,340	1,848,883	
Condensed Milk...	987,003	1,248		1,252,236	195	
Total Dairy Pro- duce	7,991,809	2,250,954	28.2	9,206,901	2,697,123	29.3
Eggs Thousands	2,625,849	90,622		2,589,069	525	
Cwt. ²	2,930,635	101,140	3.5	2,889,956	586	.02
Grand Total	31,647,897	6,795,712	21.5	34,945,653	9,021,038	25.8
Empire Deficiency	24,852,185			25,924,615		

¹ The meat obtained from the imported cattle, which were mainly mature animals slaughtered on arrival, has been taken as averaging 6½ cwt. dressed weight. The meat obtained from imported sheep has been taken as averaging 56 lbs. dressed weight. For the details of these co-efficients, see (Cd. 8448), pp. 166, 167.

² Imported eggs have been taken as averaging 8 to the lb. or 896 eggs to the cwt. This may be slightly under the actual average owing to extensive importations of small-sized eggs from Russia and elsewhere.

three main groups, namely, meats, dairy produce, and eggs; and also the total quantities and the percentages received from British possessions in each case. The quantities have all been converted to hundredweights for convenience in estimating the final totals, as this method appears to be better than that of working by values. The purpose of the table is not only to show the actual position in 1913, but also to make clear the trend of the changes in sources of supply, between the beginning of the present century and the outbreak of the war. The original figures have been taken from the Returns of Agricultural Statistics published by the Board of Agriculture, and the quantities are expressed in full, down to units of hundredweights, in order to give a clear view of certain small items which would otherwise have to be omitted.



A study of this table brings to light a number of interesting facts. In the thirteen years covered by the table the contribution of the Overseas Empire to meet the deficiency of the United Kingdom in all animal foodstuffs taken together by weight, rose from 21.5% at the beginning to 25.8 at the end of the period. The greatest increase among the various items was in meat of all kinds, the rise in this group amounting to over 6% of the total imports, as compared with a similar rise of less than 4½% of all animal foodstuffs. This was due mainly to an expansion in the Australian export trade in refrigerated beef and mutton. There was a much smaller increase in the percentage of dairy products supplied by the British possessions, notwithstanding a large increase in that of cheese and an increase of about 1% in that of butter. This is accounted for by the marked expansion in the imports of margarine and of condensed milk, neither of which was consigned to the United Kingdom in any but the smallest quantities from other parts of the Empire. The item of eggs calls for special remark; not only were the supplies from Imperial sources more or less insignificant in 1900, but they declined to practically nil in 1913, owing to the disappearance of the Canadian surplus consequent upon increased local consumption. In fact, the position for the Empire was really worse in the matter of egg production in relation to consumption than is shown by the figures in the table above, because of the large imports of eggs into Canada from the United States in 1913.¹ It is somewhat

¹ The average net annual imports of eggs into Canada in 1912-14 amounted to over 12 million dozen or about 160,000 cwt. The Empire's deficiency in

remarkable that the British Empire should show such an enormous deficiency in eggs, seeing that extensive cereal-producing regions exist within its borders.

It will be seen also from the table above that the only item in which the deficiency in the United Kingdom was mainly covered from other parts of the Empire is cheese, while the percentage of the total imports so supplied rose from 59% in 1900 to over 80% in 1913. Since the latter date, the production of cheese in the Empire has increased rapidly, especially in New Zealand; the total surplus from the producing areas was over 2½ million cwt. in 1916, and this quantity is "quite sufficient to cover the deficiency in the United Kingdom and other parts of the Empire where home production does not cover consumption."¹ It is possible also, that further increase may take place in the future in the surplus of cheese from Canada and New Zealand, and "it is not improbable that the production of cheese in the United Kingdom could be increased."¹ If these conditions are realised the Empire may either become a surplus-area in cheese, or it may increase its pre-war cheese consumption and thereby reduce its meat consumption² and so lessen its dependence upon foreign sources of supplies of animal foodstuffs.

In spite of a considerable expansion in the Australasian exports of butter in the period under review, the percentage of the total deficiency in the United Kingdom in this commodity derived from Imperial sources, rose but little, the figures being 19·4% in 1900 and 20·5% in 1913. In the latter year the enormous quantity of over 3¼ million cwts. was imported from foreign countries. It should be noted that certain limited quantities of butter were exported from Australia and New Zealand in 1913 to countries outside the Empire, in which year also Canada received about 60,000 cwt. from the same sources.³ The percentage of the butter imports of the United Kingdom supplied by the Empire would have risen more, but for the changing situation in Canada. In the period 1901-05 the exports of butter from Canada averaged over 300,000 cwts. per annum, while by 1913, as we have seen, there were appreciable net imports into the Dominion. The Canadian export trade in butter has, however, reappeared since the outbreak of the war, over 100,000 cwts. being exported to the United Kingdom in 1916; but the future of this trade is very uncertain owing to the proximity of the great American market, capable of absorbing not only any moderate Canadian surplus of butter, but large quantities of cream

eggs in 1913 amounted, therefore, to over 3 million cwt., since exports of eggs from the Empire to foreign countries were negligible. (The Canadian fiscal year ends on March 31st. Here and elsewhere in this section the Canadian trade figures for the period 1912-14 are for the two years ending March 31st, 1914.)

¹ Dominions Commission Final Report (Cd. 8462), p. 184.

² For a discussion of the possible substitutes for meat, see Part II., Chaps. ii. and v.

³ Average of the two years ending March 31st, 1914.

and milk also. The Australian exports of butter, which rose considerably between 1901 and 1913, have since declined owing to unfavourable weather conditions. A survey of the Empire's butter-producing resources does not point to any likelihood of a large increase in the near future either in the United Kingdom or in the temperate Dominions. In the former the demands made upon dairy herds for whole milk are very great and any surplus milk can apparently be better used for increasing the output of cheese rather than of butter, while in Canada and New Zealand the tendencies are strongly in favour of sacrificing the production of butter to that of cheese. Only in Australia, where little cheese is manufactured, does it appear likely that the surplus of butter may increase, and that only if the country escapes destructive droughts. Even when peace conditions are restored, it is quite unlikely that Denmark and Siberia, which were the two principal sources of supply in the years prior to 1914, will resume at once their extensive exports of butter to the United Kingdom on the old scale. In the meantime, however, the manufacture of margarine as a substitute for butter has expanded very rapidly in the United Kingdom, and it happens that the raw materials used are largely produced within the Empire. In discussing the question of the Empire's deficiency in feedstuffs above, attention was drawn to the possibility of diminishing the dependence upon foreign sources of supply by an extension of the industry employed in the treatment of oleaginous nuts and seeds of Imperial origin. It is obvious also, that the Empire's dependence upon foreign sources for supplies of butter could be materially reduced, if home-produced margarine continued to be used extensively as a substitute for butter after the close of the war, as at the present time (1917-18). There does not appear to be much immediate prospect of increasing the Empire's production of butter to an appreciable extent without materially reducing its output of cheese, a course which for some time to come is likely to be undesirable. It will be shown later that special difficulties lie in the way of any very rapid expansion of the dairy industry throughout the Empire.¹ Besides the United Kingdom, the only other part of the Empire that requires to make regular net importations of butter is South Africa. Fortunately, however, in quite recent years, the deficiency of the Union in butter has declined to very small proportions, the net imports having fallen from 67,000 cwts. in 1908 to about 3,000 cwts. in 1916. The dairy industry in South Africa is making progress, and it is probable that it may even have a small net surplus of butter in the future.

With regard to condensed milk, a glance at the table shows that the imports of this commodity into the United Kingdom increased appreciably between 1901 and 1913, while the supplies derived from other parts of the Empire, which were trifling in the earlier

¹ See below, Chap. ii.

year, had dwindled to practically nothing by the later one. Recently, however, there has been a considerable increase in the production of condensed and dried milk in Australia¹ and New Zealand, and these countries may have a considerable surplus for export in the near future. It is possible, also, that the output of the United Kingdom in this direction may increase materially in the future. On the whole, however, the Empire's production of milk appears to be limited, and if large quantities are diverted to milk-condensing and drying factories, the production of butter and cheese may suffer unduly. The Empire's shortage of milk in 1913, as represented by the imports of dairy produce from foreign sources into the United Kingdom cannot have been much less than 100 million cwt.,² or about 1,067 million gallons. Butter production accounts for much the largest share of the Empire's output of milk; and unless the latter is unexpectedly increased to a considerable extent, the only way in which the Empire's consumption of cheese, condensed milk, and margarine, can be met from its production of those articles, will be by a marked reduction in its consumption of butter.

The question of the Empire's supplies of meat calls for some additional remarks. The table on p. 284, above, shows that the imports of live animals, which were considerable in 1900, had practically disappeared by 1913. In the earlier year these animals came mainly from North America, and the Canadian exports represented practically the whole of that from Imperial sources. In this connection, it should be noted that a considerable trade in live animals still remained in 1913 between Canada and the United States. On an average of the two years ending March 31st, 1914, the net exports of cattle from the former country to the latter amounted to about 110,000 head, while the corresponding net imports of sheep amounted to over 204,000 head. These two items, when converted into terms of dressed meat, would make a balance of net exports from Canada. No other part of the Empire either imports or exports live food-producing animals to any appreciable extent. Until quite recently, South Africa was a considerable net importer of meat, but since 1914 South Africa has commenced an export trade in beef which has possibilities of further expansion, while the imports of meat have declined notably. The Empire's deficiency in meat was somewhat less than that shown in the table above, owing to the fact that in addition to the net exports of live animals from Canada to the United States, Australia exported appreciable quantities of refrigerated and preserved meat to the Phillipines and other parts of the Pacific outside the Empire.³

¹ The expansion of this industry in Australia is shown by the fact that whereas in 1908 there were net imports of prepared milk amounting to 8·8 million lbs., by 1912 there were net exports of ·6 million lbs.

² This total has been obtained by reckoning 28 lbs. of milk to 1 lb. of butter, $\frac{1}{4}$ lb. of milk to 1 lb. of margarine, 10 lbs. of milk to 1 lb. of cheese and 2 lbs. of milk to 1 lb. of condensed milk.

³ It would appear that the Empire's dependence upon foreign countries for

Although the trade in horses is not directly connected with that in animal foodstuffs, it is interesting to note in this connection that the Empire, as a whole, imported in the period 1908-13 more horses than it exported, though the difference was not very considerable. If it were so, some account would have to be taken of it, since the agricultural resources devoted to the rearing of horses, could presumably be utilised for food-producing animals.

The position of the Empire in the production of wool in relation to its consumption of this material, offsets in some measure its enormous deficiency in animal foodstuffs. The British Empire produces between 40% and 50% of the world's total, and has a surplus above consumption of about 600 million lbs. annually, representing over $\frac{1}{4}$ of the total consumption of foreign countries. This is not all, because an important part of the Empire's apparent consumption is re-exported to foreign countries in the form of woollen goods from the United Kingdom. When this item is allowed for it is probable that the Empire's virtual surplus of wool is upwards of 800 million lbs. or, say, 7 million cwt., which may be taken as having at least the same value lb. for lb. as meat in terms of agricultural resources required for its production.

The study of the Empire's deficiencies in animal foodstuffs and also in animal feedstuffs, made in this chapter, points throughout to its lack of widespread intensive systems of agriculture, capable of supplying its high level of consumption in animal foodstuffs. Land resources are abundant, but they remain either partially or completely undeveloped in large areas. In the last resort it appears to be a question of insufficient man-power applied to agriculture. The agricultural industries in the temperate parts of the Empire are working almost everywhere mainly on the extensive plan, and thus utilise a minimum of human labour in proportion to the land area employed and to the output. Throughout those parts of the Empire inhabited by white people it is probable that a smaller proportion of the entire population is engaged in agriculture than is to be found in any other political division in the world. It is stated that the Dominions could all greatly increase their surplus of foodstuffs, given an increased agricultural population; and the same is certainly true of the United Kingdom. The Empire, as a whole, requires to have an enormously increased area under cultivation for the production of feedstuffs, not only to make good its deficiency in this direction, but also to provide for the maintenance of food-producing animals and of poultry in much larger numbers than at present, if it is to cover in a more satisfactory way its deficiency in meat, dairy produce and eggs.

its supplies of meat has increased rather than diminished since 1913. In that year the exports of frozen and chilled meat from the British Possessions amounted to 40% of the world's total output of such products, while by 1916 they had fallen to 32%. This is partly a temporary phase, being due to transport difficulties under war conditions, to the drought in Australia, and to abnormal exports from the United States, but it is due also to increased exports from South America which are likely, as we have seen above (Part I. Chap. iv., p. 61), to grow still further.

CHAPTER II.

THE OUTLOOK FOR THE FUTURE IN PRODUCTION.

THE question now to be considered is to what extent the consumption of animal foodstuffs within the Empire may in the future be covered by its production of these articles. The United Kingdom has hitherto been the principal market for the exports of the surplus-producing countries both within the Empire and outside it; but it may not remain so in the future for the surplus exports of foreign countries, owing to the competition of countries on the Continent, and perhaps of the United States also, for a share of these exports. The Empire's marked shortage in animal foodstuffs is due to its high per capita consumption, combined with the great development of manufacturing industries in the United Kingdom, together with the prevalence of the extensive forms of agriculture throughout the temperate parts of the Empire. In other words, the average agricultural output per capita in those parts of the Empire inhabited by white people bears a smaller proportion to the average per capita consumption of foodstuffs, than in most other regions inhabited by Europeans. In recent years there have been but few indications that this proportion is being increased.

With regard to animal foodstuffs we have seen that between 1900 and 1913 a small increase took place in the proportion of the total deficiency of the United Kingdom supplied by other parts of the Empire. At the same time, however, the proportion of the total consumption of the United Kingdom supplied from its home production declined on the whole, and especially in dairy products. The Empire, therefore, did not become appreciably less dependent upon foreign countries for its supplies of animal foodstuffs in this period. An examination of the per capita ratios of food-producing animals to population in the British Empire supports this conclusion. The following table shows the per capita ratios of cattle, sheep, pigs and "cattle units" in the United Kingdom, Canada, South Africa,¹ Australia and New Zealand taken together,² in the years 1890, 1900 and 1911.

¹ For South Africa the figures for 1904 have been taken under the years 1890 and 1900 since the figures for these years were not obtainable. This makes no serious difference for comparative purposes.

² The productiveness of live-stock, as shown by the percentages of slaughtering to enumerations, varies greatly in different parts of the Empire, being much greater in the United Kingdom than, for example, in Australia. To this extent the table is open to criticism.

	1890	1900 ¹	1911
Cattle	·59	·54	·61
Sheep	3·2	2·48	2·8
Pigs	·16	·14	·14
" Cattle Units "	1·34	1·15	1·27

It will be seen that, although the ratio of cattle units to population was high throughout, it fell during the period 1890-1911. Nevertheless, the output of meat per capita of the population probably rose rather than fell, owing to increased production in proportion to enumerations, especially in the matter of the large item of sheep in Australia and New Zealand. It will be observed also, that while cattle almost exactly maintained their ratio, that of sheep declined noticeably, in keeping with the movement in progress in almost all sheep-rearing regions; but the Empire's sheep-ratio of 2·8 head per capita in 1911 is considerably higher than that of all important foreign countries except Argentina. The decline in the Empire's pig-ratio, as shown in the above table, is remarkable in view of the upward tendency in other parts of the world, and in view also of the fact that the ratios themselves are low as compared with those of a number of foreign countries. This relatively small and declining ratio of pigs to population gives rise to one of the Empire's greatest weaknesses in meat production.

During the period under review the United Kingdom showed, of course, a marked decline in the ratios of food-producing animals to population, while the Dominions, with minor exceptions, showed an increase all round. The sum total of the latter increases, however, was barely sufficient to maintain the balance. The tendencies revealed by a study of the above figures do not promise well for the future. The movements in the live-stock ratios do not indicate that the Empire will be able to meet its consumption of animal foodstuffs out of production to a much greater extent in the near future than in the past, unless the per capita consumption is materially reduced. The only hopeful feature is that the ratios of sheep and cattle are high and that the meat-producing capacity of these animals per annum in proportion to their numbers may be raised. So far, however, as cattle are concerned, the proportion of dairy cattle to beef stock has been rising. This movement, if continued, while it would improve the situation with regard to dairy produce, may affect unfavourably the output of beef. The raising of the ratios of food-producing live-stock within the Empire appears to be urgently necessary, if the latter is to become more self-sufficing in animal foodstuffs. In the United Kingdom in the absence of greatly increased cultivation, this could not be done on a large scale without an enormous increase in the imports of feedstuffs, mainly, perforce, from foreign sources; and in view of the probable high cost of ocean freights for some time to come, it will be found cheaper and more economical to import the finished animal

¹ The figures for 1900 are abnormally low owing to drought condition Australia.

foodstuffs. In the Dominions there may appear to be room for considerable expansion in animal industries, but, as has already been observed, such expansion under the more intensive systems now become necessary, demands a largely-increased agricultural population in those countries. The war, unfortunately, has reduced the normally somewhat slow increase in their agricultural populations by cutting off immigration and by the enlistment of many into the armies, and when immigration into the Dominions once more sets in, it will be some considerable time before this will be effective in causing any marked increase in their surplus of agricultural produce.

The lack of sufficient agricultural population appears to be of such importance among the factors that contribute to the deficiency of the Empire in animal foodstuffs, that it calls for further discussion. It is well known, of course, that during the last half century there has been a constant stream of migration from the agricultural districts to the towns in Great Britain, owing to the prevailing low prices for agricultural produce. This has led to a constant increase in the deficiency of the United Kingdom in foodstuffs, which has not been balanced by a corresponding increase in the surplus output of the rest of the Empire.¹ During this time the Empire has lost altogether a great number of able-bodied agricultural workers by emigration from the United Kingdom to the United States. In fact, till 1906 and even later, the competition of the United States with its enormous agricultural resources in process of development, was perhaps the prime factor that hindered a more rapid development of the British temperate agricultural regions. This competition made itself felt against the latter regions in two ways that subtly reinforced each other; in the first place, the United States was able, till quite recently, to attract a large proportion of the emigrants from the United Kingdom, and in the second, by its vast and cheap surplus agricultural production, made it difficult for farmers in any part of the British Empire to compete successfully in the British market. We have seen that, in recent years, the North American net surplus of animal foodstuffs has fallen remarkably² and correspondingly the proportion of the total emigrants from the United Kingdom bound for the United States has declined noticeably, while that of the same to the British Dominions has increased³; indeed, since 1908, there has been

¹ The total *quantities* of foodstuffs imported into the United Kingdom from foreign countries have increased notably, although the *percentage* of the total imports supplied by the Overseas Empire has also increased. See Table, p.

² Part I., Chap. iv., pp. 43-55 and Chap. viii., p. 141. Note 1.

³ The net emigration from the United Kingdom to the United States and to the Overseas Empire respectively was as follows for the years 1901 and 1913.

	TO UNITED STATES.	TO OVERSEAS EMPIRE.
1901	45,883	25,239
1913	52,155	188,635

an appreciable net migration of farmers and agricultural workers from the United States to Canada. It may be assumed, therefore, that for the present and for some time to come, the United States has more or less ceased to be a serious competing force, either by superior attractions for emigrants or by cheap surplus production,¹ with the temperate areas of the British Empire.

With the somewhat rapid decline in the American competition in the production of foodstuffs, the Overseas Dominions have, however, had by no means a clear field in the British market. Since the year 1900 temperate South America, and especially Argentina, has come into prominence as a surplus-producing area in foodstuffs, more particularly in meat.² This region has not attracted much emigrant population from the United Kingdom hitherto, nor is it likely to do so in the future. Its resources, however, are enormous and agricultural production is not only on a vast scale, but is cheaper than almost anywhere else in the world. Its exports of meat continue to expand, without a corresponding increase taking place in the total exports of the British Overseas Dominions.³ As we have seen, however, it is possible that much greater quantities of Argentine and South American meat will find their way in the future to Continental markets: and in this case, the animal industries of the Empire will be relieved of what would otherwise be serious competition in the British market. The effects of a probable meat shortage in the near future and of the consequent rise in prices above pre-war levels, upon the production and the consumption of animal foodstuffs in the British Empire will be discussed at a later stage.

In competing for emigrants from the British Isles the temperate parts of the Empire suffered, as compared with the United States, not only in having poorer or less accessible agricultural resources, but also in lying at a greater distance from the United Kingdom. Moreover Canada, Australia and South Africa have each of them had an evil reputation amongst intending emigrants for special reasons: Canada for the extreme coldness of its climate; Australia for its heat and droughts; South Africa for its aridity, its land question, and its unsettled political conditions, and all of them for the loneliness of life which was known to be the lot of the pioneer settler in them. Fortunately these ideas are not likely to operate so strongly in the future. The importance of improved systems of communication throughout the Empire by rail and steamship

¹ The United States still has, as already noticed, a large surplus in pig-meat and in animal fats and oils, owing to its heavy production of maize. It will be difficult for the British Empire to compete in these directions, even with a more highly developed system of agriculture than at present.

² See Part I., Chap. iv., p. 57.

³ The South American output of meat (including exports from Brazil, Uruguay and Chile, as well as those from Argentina) rose from 478,250 tons in 1914 to 529,000 tons in 1916. There are indications also that Argentina in the near future will have a surplus of pig-meat as well as of beef and mutton. See Part I., Chap. iv., p. 61. Compare also Chap. i., above, p. 288, Note 3.

has been realised and the great improvements that were made in this direction in the years immediately preceding the war, will doubtless be continued in the future.¹ The high degree of prosperity which the Overseas Dominions have enjoyed during the war—a condition that may well continue for some time in the future—will make it possible for them to develop their resources and to provide the amenities of civilisation at a more rapid rate than in the past. The great difficulty, however, in the years following the war may be to find emigrants of agricultural training that can be spared from the United Kingdom, where the numbers of agricultural workers tended to fall short of requirements even in the years prior to the war. It is generally agreed that it is of urgent importance to increase the agricultural output of the British Isles, but this cannot be done without additional supplies of labour. If these islands are drained heavily of agricultural workers by emigration to the Dominions, the position of the Empire in agricultural production may not be greatly improved, except in so far as the net output per worker may be greater in the Dominions on an average than in the United Kingdom. It would appear that in order to solve the problem, some redistribution of the Empire's man-power is required, whereby the proportion of agricultural workers may be increased at the expense of that engaged in other than agricultural pursuits.²

One prominent cause which, in the past, has operated against a more rapid increase in the population engaged in agricultural industries in the temperate parts of the Empire, is the great extent of the mining industries. The Empire's surplus in coal, for example, is just as striking as its deficiency in animal foodstuffs. The proportion of male primary producers engaged in mining and kindred industries in Australia, South Africa, Canada and even New Zealand is high relative to that engaged in agricultural production. In Great Britain the number of persons employed in the coal mining industry alone was in 1911 about three-quarters of that employed in agriculture. It is true that mining has served to attract population to the outlying Dominions, in greater numbers than would perhaps otherwise have been the case; nevertheless, it is a fact that the present proportion of the population withdrawn from agriculture by mining industries is unfavourable to the production of foodstuffs in sufficient quantities to cover the requirements of the Empire; and owing to its resources in minerals and metals, the Empire's mining industries are likely, on the whole, to expand rather than to decline in the future.

It is clear that, in view of the land resources available to the white people of the British Empire, they have neglected the business

¹ In this connection see the recommendations made by the Dominions Commission in their Final Report (Cd. 8462), Chap. ix.

² Any increase in the use of labour-saving plant and machinery in the production and transport of foodstuffs within the Empire would, of course, tend to lessen the difficulties under this head.

of agricultural production in recent times. British capital, on the whole, has rather avoided those forms of investment that contribute directly or indirectly to the development of the agricultural resources of the Empire, and this may in part explain why population has not been attracted in greater proportions to the land. Unfortunately, moreover, such capital has often been invested in railways and other enterprises in foreign countries, which have had the result of strengthening the competition of those countries against the producers of foodstuffs within the Empire. It is probable, however, that in the future less British capital will be invested in foreign countries, and that, under government or collective control, more will be found for purposes that contribute to the development of the Empire's agricultural resources. It has to be recognised that so long as the export of British private capital remains free, it naturally follows the line of apparent maximum return, irrespective of Imperial considerations, hence government or collective action seems to be the best means of obtaining adequate supplies for the purposes indicated.

It has been shown above¹ that the rate of development of manufacturing industries in any area is a question of great importance in determining to what extent it will be able to supply its requirements in foodstuffs, and particularly in animal foodstuffs. In the United Kingdom, even if an increased number of men is employed in agriculture in the future, it is probable that manufacturing industries will continue to expand steadily, at least in proportion to the rate of increase in the entire population. In the Dominions there has recently been shown a strong desire to establish local manufacturing industries, and some measure of success has attended the attempts already made in this direction. The indications are that these industries will develop at a somewhat rapid rate in certain parts of the Dominions in the future, with unfavourable results upon their net exports of foodstuffs. The whole question relating to the output of manufactures as compared with that of foodstuffs within the Empire, is very complicated. The present purchasing power of the people of the United Kingdom depends in a large measure upon widely-developed manufacturing industries, and under the free-trade system, these tend to grow at the expense of agriculture so long as foodstuffs (and raw materials) can be obtained in abundance and cheaply from elsewhere. From the Imperial point of view it seems neither necessary nor desirable that very large supplies of foodstuffs, at any rate, should be drawn from foreign countries. If, however, a world-shortage in animal foodstuffs arises in the near future—and this, as has been shown, is most probable—increased attention is likely to be given automatically to their production, not only in the United Kingdom, but throughout the Empire.

¹ See Part II., Chap. iv., pp. 235-241.

In the above paragraphs the distinction between the production of foodstuffs as a whole and that of animal foodstuffs, has not been clearly maintained. This is because of the Empire's deficiency, not only in the latter, but also in all kinds of agricultural products that depend upon arable cultivation, and because an increase in the production of the latter is a necessary condition of an increase in that of the former. Though the net deficiency of the Empire in wheat is small, it is clear from its deficiencies in other directions that the area of land under crops of all kinds—and especially of those required for the maintenance of animals—is quite insufficient to supply the requirements of its population in foodstuffs. It may be in the near future that the total production of wheat in the Empire will be equal to, or greater than, the total consumption, but much wheat is at present produced in Canada and Australia on the exhaustive one-crop system, which cannot be continued indefinitely. From every point of view, therefore, it is desirable that the cultivation of rotation crops, supplying animal feedstuffs, should be extended. If the whole of the feedstuffs so produced is not consumed by food-producing animals on the spot, the balance might be exported to those parts of the Empire where feedstuffs are now, or may be in the future, deficient, particularly to the United Kingdom. In order that the Empire's requirements in animal foodstuffs may be supplied from its own production, it appears that a large increase is required in the areas of land under cultivation in the more accessible and longer settled parts as well. The figures given in Chapter I., above, show that in addition to a deficiency of nearly 26 million cwt. of animal foodstuffs, the Empire showed, in 1913, a net deficiency of over 56 million cwt. of feedstuffs, not including the deficiency in oats for horses. These 56 million cwt. of feedstuffs would represent about 5 million cwt. of animal foodstuffs, making the total deficiency of the latter up to 31 cwt. It will be seen at once how great must be the increase in the labour and capital employed within the Empire in agriculture in order to provide not only the present deficiency in feedstuffs, but also for the maintenance of the deficiency in food-producing animals, which would themselves necessitate the employment of much additional labour and equipment.

If considerable importance is to be attached to the Empire becoming more self-contained in the matter of foodstuffs and feedstuffs, still greater weight must be given to progress in the same direction in the United Kingdom. This country, in spite of its marked deficiency, is nevertheless a greater producer of animal foodstuffs, as measured by gross values, than any other part of the Empire. Many authorities are of the opinion that the agricultural output of the United Kingdom, including that of animal foodstuffs, could be considerably increased if proper steps were taken.¹ This seems to be borne out by comparisons with neigh-

¹ See Report of the Land Enquiry Committee, 1910, Vol. I., pp. 231-254, and in addition numerous books and articles by prominent writers on British Agriculture.

bouring countries that are certainly not more favoured in soil and climate.¹ It is maintained that the output in these directions could be materially increased, if more land were under rotation crops, without any marked increase becoming necessary in the quantities of feedstuffs imported.

Some changes could probably with advantage be made in the distribution of resources among the various food-producing animals. In particular, the United Kingdom is obviously understocked with pigs and dairy cattle, both of which are more efficient converters of feedstuffs into foodstuffs than beef-cattle and sheep, now so prominent in numbers among British live-stock. The Corn-Production Act of 1917 aims at increasing the acreage under cereals mainly by the conversion of pastures to arable; but there is no reason why, as some suppose, the production of animal foodstuffs in the United Kingdom should be diminished, even if the cereal acreage is greatly increased. Rotation farming, under intensive methods, is more favourable to animal industries than is the simple grazing system; and a widespread increase in cereal-cultivation in the United Kingdom would certainly be favourable to an expansion in the poultry-rearing industry, which is at present quite unable to meet the requirements of the population in eggs.

It is possible, therefore, that the deficiency of the United Kingdom in cereals (including feedstuffs) and in animal foodstuffs may be materially reduced in the future, provided sufficient agricultural workers of the right kind are to be found. This, as we have seen, may prove to be a serious difficulty in view of the competing attractions of the Dominions and of the towns in the United Kingdom for able-bodied men. Nevertheless, it is hardly to be supposed, even if the available land in the United Kingdom is made to produce the maximum of foodstuffs, that the country will ever be able, on the present basis of consumption, to supply the whole of its requirements. It was estimated that before the war the United Kingdom produced about one-half of its total consumption of foodstuffs, by values; but it produced less than one-half of its total consumption of animal foodstuffs by values when the imports of feedstuffs are included with those of these articles. It appears that in the future it will almost inevitably show some deficiency in animal foodstuffs, in certain feedstuffs, and in wheat. Hopes are, however, entertained that the deficiencies in these directions will be more or less entirely supplied from the surplus production of the rest of the Empire. Still the evidence at present available points to the conclusion that it will be a long time before this is accomplished, and that great progress in agricultural production, and especially in animal industries, will have to be made in the meantime throughout the Empire.²

¹ See T. A. Middleton's *Report on German and British Agriculture* (Cd. 8305); Rowntree's *Land and Labour, Lessons from Belgium*; Rider Haggard's *Rural Denmark*.

² The production of meat per head of live-stock is much lower in the Overseas Dominions than in the United Kingdom, and it is thought by some author-

In order to complete this chapter some reference may be made to two widely different parts of the Empire that have not hitherto been mentioned, namely, Newfoundland and India. The first is a deficiency area, about 34% of its total meat supplies being imported.¹ Neither the climate nor the soil are very favourable to agriculture, and the principal industries of the country are connected with timber and fish. Agriculture may make greater progress in the future, when more of the land is cleared of forest; and the surplus fish exported from the country may, if sent in larger quantities to other parts of the Empire, be valuable in relieving in some measure the Empire's shortage in meat by being used as a substitute for it in consumption.

India, according to official figures, has more cattle than any other country in the world, and has, besides, considerable numbers of sheep and goats. Owing, however, to the peculiar climatic and economic and social conditions of the country, both the production and the consumption of animal foodstuffs are small, and there is no surplus for export. The same conditions are likely to obtain in the future. On the other hand, the Indian exports of wool and of hides are considerable. It should be noted that the exports of wool from a region such as India favour the changes in progress in the sheep-rearing countries, from wool-producing to mutton-producing sheep; while the exports of hides rather depress cattle-rearing industries elsewhere by lowering the price for the joint product of leather.² India's contribution to the production of animal foodstuffs within the Empire is an indirect one. Already very large quantities of oil-bearing nuts and seeds are exported, and these quantities may increase further in the future if the demand for them expands. The importance of these products in different aspects in connection with the subject-matter of this enquiry has been referred to more than once above.³

The main points in this chapter may now be summarised. The Empire's marked deficiency in animal foodstuffs and in the feed-stuffs required for the maintenance of food-producing animals, can be remedied only by a great increase in the labour and capital devoted to agricultural production within its borders. Incidentally it may be possible to increase the production of food per head of live-stock in the overseas countries. Unless changes in this direction are made on a much greater scale than in the years 1901-13, the Empire as a whole may become increasingly dependent in the future upon foreign sources for supplies of the above-mentioned

ities that suitable improvements in the live-stock of those areas would lead to a considerable increase in their surplus of meat available for export to the United Kingdom. See Hooker, *Statistical Journal*, June, 1909, pp. 351, 352, also Weddel & Co. Memorandum on the Imported Meat Trade of the United Kingdom, April, 1917, p. 17.

¹ Dominions Commission, Fourth Int. Report (Cd. 7711), p. 10.

² See Part II., Chap. v., above, pp. 260-263.

³ See Part I., Chap. viii., Part II., Chap. ii.; Part III., Chap. i.

classes of produce. However, changes of this kind are difficult to carry out rapidly, owing to the extent to which mining and manufacturing industries are followed in various parts of the Empire, but they will be assisted by the fact that emigrants from the British Isles will be attracted mainly to the British Dominions in the future rather than to foreign countries.

There may be some appreciable increase in the net agricultural output of the United Kingdom in the future, but this can be achieved only by the employment of greater numbers of agricultural workers. This would tend in consequence to deprive the Dominions in some measure of the additional population in the form of immigrants, which they urgently require for the proper development of their agricultural resources. However, if prices for agricultural produce remain at a high level compared with those of other goods for some time in the future, population within the Empire will be attracted to a greater extent than in the past to agriculture. As the Empire possesses greater undeveloped temperate agricultural resources in proportion to its white population than most other political divisions in the world, it would have a competitive advantage in supplying its own markets with foodstuffs under these conditions ; and it would have special advantages in resources, both temperate and tropical, for remedying to some extent its deficiency in animal foodstuffs, during the time of world-shortage of these products that is to be anticipated in the near future.

CHAPTER III.

THE CONSUMPTION OF ANIMAL FOODSTUFFS IN THE EMPIRE

IT has been assumed hitherto that the rate of consumption of animal foodstuffs within the British Empire will remain at approximately the same level in the future as that of the past. The future rate of consumption, however, depends upon the extent of the supplies available at prices that consumers can afford to pay. It is difficult to forecast what margin of income the average British consumer will have at his disposal in the future for the purchase of animal foodstuffs; the average rates of wages may rise without this margin being in any way increased. The price levels of animal foodstuffs are likely to remain permanently higher than they were in the period 1901-13, since during that period the tendency was already towards an upward movement; and in the future these price levels may be so high in relation to the purchasing-power of the average consumer that the per capita consumption may fall. The reduction in the rate of consumption which may arise through certain forms of substitution being adopted in the British Empire will be considered later. It is obvious that if the per capita rate of consumption of these foodstuffs rises or falls through any cause in the Empire in the future, its deficiency as a whole in them will tend to be correspondingly increased or reduced.

	MEAT CON- SUMPTION PER CAPITA. ¹ lbs.	POPULATION. millions.	TOTAL MEAT CONSUMPTION mill. lbs.
United Kingdom...	115	45.2	5198
Canada	137	7.2	986
Australia	262	4.6	1205
New Zealand	212	1.2	255
	Totals	58.2	7644
	Average per capita con- sumption.		131 lbs.

¹ The estimates for years nearest to 1911 have been taken in those cases where no estimate is to be found for that year. The figures represent dressed meat exclusive of edible offal

The per capita consumption of animal foodstuffs in the temperate regions of the British Empire has been relatively high. That of meat is shown in the table above, giving the estimated meat consumption per capita, the population, and the estimated total of meat consumed in each of the leading parts of the Empire,¹ together with the Empire's average per capita consumption, in the year 1911

A comparison with other areas² shows that the per capita meat consumption is higher, according to the estimates made, only in the United States and Argentina, in both of which, however, it shows a tendency to fall.

In other animal foodstuffs also the per capita consumption of the white population of the Empire has been high as compared with other countries. Thus the milk equivalent of the per capita consumption of butter and cheese in the four divisions of the Empire, taken above, averaged about 53 gallons in 1911 as compared with a similar milk equivalent of about 49 gallons in the United States. The per capita consumption of whole milk in the United Kingdom is lower than that of some other countries, but it is apparently high in the Dominions, and the consumption of margarine in the United Kingdom has not been allowed for above. These facts would indicate that the Empire's consumption of animal foodstuffs has been a comparatively liberal one, and it is possible perhaps for some reduction to take place in the average rate without loss of efficiency or the infliction of any great hardship. The statistics available show that the estimated per capita rate of meat consumption declined somewhat in the United Kingdom in the period 1901-13, and it probably remained more or less stationary during the same time in the other parts of the Empire. On the other hand, the per capita consumption of dairy products³ and of eggs⁴ apparently increased throughout the Empire in the above-mentioned period. These complementary movements may continue in the Empire's consumption of animal foodstuffs in the future, in keeping with the economies of production.⁵

We have seen above that the future rate of consumption of animal foodstuffs among the white people of the British Empire

¹ Only those parts that are inhabited by white population are included. South Africa has been omitted because of the large native population.

² See above, Part II., Chap. ii., p. 205.

³ The net imports per head into the United Kingdom of butter, of condensed milk, and of margarine increased appreciably, while those of cheese declined somewhat, in the period 1900-13, but the milk equivalent of the increase in the three former is much greater than that of the decline in the latter. During the same period the per capita production of milk in the United Kingdom appears to have remained about stationary. The per capita consumption of dairy products in both Canada and Australia is known to have increased since the year 1900.

⁴ The imports of eggs per head into the United Kingdom increased from an annual average of 46.4 eggs in the years 1898-1900 to that of 52 eggs in the years 1911-13, while the home production apparently also increased. (See [Cd. 6277], p. 16.)

⁵ See Part II., Chap. v., above, pp. 265-271.

will depend in general upon the relations obtaining between supplies and prices on the one hand, and the average purchasing power on the other ; but independently of this general law, certain tendencies that are likely to operate call for remark.

First, the per capita rate of consumption is certain to continue to be greater in the surplus-producing parts of the Empire than in the United Kingdom. Hence a more rapid rate of increase in population in the Dominions than in the United Kingdom, leading to an increased proportion of the total white population resident in the former, would tend to raise the Empire's per capita consumption ; though it would tend to reduce the Empire's net deficiency, owing to the more than proportionate increase in production likely to result therefrom.

Second, in consequence of the anticipated shortage of meat, the Empire's per capita consumption of cheese, which, prior to 1914, was relatively low, will tend to rise. Hitherto, owing to the comparative cheapness and abundance of meat, the people of the British Empire have not utilised cheese so largely as an article of food as those of some continental countries. Not only, however, does the Empire already produce the greater part of the cheese it consumes, but there is no doubt that, by reducing its output of butter, sufficient cheese could be produced within the Empire to meet a greatly increased consumption.

Third, the Empire's per capita consumption of butter has been high, and any increase in that of cheese will tend to reduce the supplies of milk available for butter production unless the Empire's dairy herds increase unexpectedly. Moreover, margarine has now become established in the United Kingdom as a recognised substitute for butter, and as shown above,¹ the Empire's deficiency in animal foodstuffs and feedstuffs makes the increased consumption of margarine from its own factories highly desirable. In the Dominions, however, owing to conditions brought about by the butter-producing and exporting industries, margarine appears likely to remain almost an unknown article of food, and the per capita consumption of butter in them will tend to remain very high.

Fourth, while the tendency in the per capita rate of meat consumption in the decade prior to 1914 was apparently downwards, this movement is not likely to proceed much further without some appreciable increase in the per capita consumption of dairy products. The climatic conditions under which most of the white people of the Empire live, and the traditional importance of meat in their dietary, will make a per capita meat consumption of, say, 120 lbs., the minimum standard in the future. It is to be observed that any social or economic changes in the United Kingdom that result in an increase in the relative purchasing power of the industrial and labouring classes, tend indirectly to raise the Empire's per

¹ See Part III., Chap. i., p. 287.

capita consumption of animal foodstuffs. This has hitherto, on the average, been well above the minimum required for efficiency ; but the distribution has been unequal as between different social classes in the United Kingdom, and certain sections of the population have not in the past been able to supply themselves with a sufficient proportion of the more concentrated animal foodstuffs.

Finally, the Empire's per capita consumption of fish was rising in the period 1890-1913, as indicated by the quantities of fish available for consumption in the United Kingdom, and the fisheries of the Empire yielded a net surplus by weight above consumption. This tendency towards an increased per capita consumption of fish is likely to continue in the future, especially in the United Kingdom and Canada, where supplies of fish are naturally abundant, and where the people will have learned to appreciate more fully during the war-period the value of fish as a substitute for meat. A largely increased consumption of fish would perhaps make it possible to reduce the minimum per capita consumption of meat, above indicated, below that level without undesirable consequences.

With reference to the margin of spending power available for the purchase of animal foodstuffs, it has been shown above ¹ that the price level of the staple cereal foodstuffs is one of the component elements that determine its extent. High prices for the latter involve not only correspondingly high prices for the former, but they cause a reduction in the margin left for the purchase of these more costly foodstuffs. Now among the white people of the British Empire the chief cereal foodstuff is wheaten bread. It does not appear likely, owing to the great resources available both throughout the world and in the British Empire for the production of wheat, that its price will rise permanently to a much higher level in the future than in the past ; so that it is improbable that the resources in the hands of the poorer classes in the United Kingdom for the purchase of animal foodstuffs will be seriously diminished by an increase in the price of bread.

¹ See Part II., Chap. iv., pp. 237, 238.

CHAPTER IV.

THE EMPIRE'S TRADE IN ANIMAL FOODSTUFFS AND FEEDSTUFFS.

THE scattered nature of the British Empire gives rise to special problems in the supplying of its requirements in foodstuffs and feedstuffs from its own resources. Geographical conditions tend to cause each of the more important divisions of the Empire to follow a separate economic existence, to develop trade relations with foreign countries independently of the rest. It has been already observed that the British Empire as a whole has in recent years produced wheat in quantities almost sufficient to meet the requirements of its consumption ; nevertheless, in 1913, less than one half of the imports of wheat into the United Kingdom were derived from Imperial sources. The same peculiarities are apt to hold in the trade in other bulky items of foodstuffs and feedstuffs which are produced in considerable quantities in the Empire, and which are at the same time staples of the world's commerce.

In order to ensure that the greatest possible quantities of foodstuffs and feedstuffs produced in surplus in different parts of the Empire shall be directed to supplying the deficiencies in these articles in other parts, it is imperative that the lines of transport by rail and sea shall be developed to the utmost. The advantages of lower freight charges naturally cause bulky goods to be shipped the minimum distances to a market. Russian barley, for example, has found its way in large quantities to the United Kingdom, while some of the surplus Canadian barley was exported to the United States, and while farmers in the more distant parts of the Empire who might have grown barley, were prevented from doing so by the impossibility of competing against producers more favourably situated with regard to the British market. Not only, therefore, has the surplus production of foodstuffs and feedstuffs, in which the Empire as a whole is deficient, been diverted from certain parts of the Empire to foreign countries, but the Empire's production of some of them has been restricted by transport and market difficulties.

It is clear that this kind of interference with inter-Imperial trade is most likely to occur in the case of the more bulky cereals and feedstuffs, and least likely in that of the more valuable foodstuffs, such for example, as butter. The trade in perishable produce, such as meat, butter, cheese and eggs, over long distances is particularly dependent upon specialised and regular means of transport. Even in meat there has been some interference with inter-Imperial trade owing to the conditions imposed by geographical situation. Thus, for example, Australian meat has been exported in consider-

able quantities to Pacific ports outside the Empire, while Argentine meat of a similar kind was being imported into the United Kingdom.

It has been stated in Chapter I., above, that the total imports and the total exports of animal foodstuffs between the overseas parts of the British Empire as a whole and foreign countries approximately balance each other, and that the same is true of animal feedstuffs. These movements may now be examined in greater detail with reference to the separate items, in order that any marked tendencies may be noted with reference to future developments. Among the Dominions, Canada has been the greatest importer of animal foodstuffs from foreign countries, and Canada and Australia the greatest exporters. The Canadian trade has been mainly with the United States.¹ It has been noted above² that Canada and the United States are now practically one area with reference to the production and the consumption of animal foodstuffs and feedstuffs, since the changes in the American tariff in 1913. The geographical conditions will naturally favour an increase in this exchange trade over the international frontier in the future, owing to the differences in soil, climate and economic conditions on either side of it. If, particularly, a shortage arises in the United States in a special kind of animal foodstuffs, any Canadian surplus in that article is more likely, in the ordinary course of trade, to move southwards by rail than to cross the ocean to the United Kingdom.³ In this connection it is to be observed that wages and purchasing power are relatively high in the United States, and that the average American consumer can afford to pay a high price for the surplus foodstuffs of other countries, if a threatened or actual shortage again occurs in his home supplies.

The Australian export trade in butter and meats to Eastern countries shows clearly the influence of geographical position. The total value of these exports in 1912 (which were mainly to places outside the Empire) was over half a million sterling—more than double the value of the same exports in 1901. It is uncertain whether this trade will expand at the same rate in the future as it did in the period 1901–12, but even if it develops at a moderate rate only, it will, in the near future, be a feature of no small importance. An examination of the distribution of the Australian export trade in tallow and in wheat and flour, shows that large quantities of these products also have been consigned to places

¹ In the period 1909–1913 the most important items in which there were excess imports into Canada from the United States were meats, lard, eggs, live sheep, oil-cakes and maize, while among those in which there were excess exports were milk and cream, live cattle, oats and barley. In a number of these articles there were trade movements from each country into the other, and in some others, such, for example, as butter and cheese, there were considerable movements from Canada into the United States and *vice versa*, which more or less balanced each other.

² See Part I., Chap. iv., p. 53, Note 2.

³ This is well illustrated by the export trade in cattle from Western Canada in recent years. See (Cd. 8458), QQ. 694–718,

outside the Empire, notably to foreign countries in Europe. The tallow may have been partly used in some of these countries as an ingredient in the manufacture of margarine, and the wheat, of course, produced offals used as feedstuffs. On the whole, while the bulk of the Australian exports of animal foodstuffs and feedstuffs is consigned to the United Kingdom, it appears that of the remainder a smaller proportion is sent to other parts of the Empire, and a larger proportion to foreign countries in the Western Pacific or in Europe. The growing tendency of Australia to trade with countries outside the Empire was a marked feature of the years prior to 1914. If, as has been reported, the American Beef Trust has established control over certain Australian freezing works, this may lead to the diversion of a larger part of the Australian meat surplus to such foreign destinations as these large operators may find it profitable to send it. It is noteworthy that the Australian imports of animal foodstuffs and feedstuffs are, on the average of years, very small, and that these come mainly from New Zealand.

There is a distinct possibility of exports of dairy produce, and even of meat, finding their way in the future from both Australia and New Zealand to the United States, if a shortage in these articles reappears there and high prices are offered. Since the opening of the Panama Canal there has been direct shipping communication between Australia and both the East and the West coast of North America; and the vessels, which are heavily laden with American merchandise and raw materials outwards, can easily carry foodstuffs back, since return cargoes are short.

We now pass on to a more detailed study of the trade in animal foodstuffs and feedstuffs between the various overseas parts of the Empire themselves. Under this head Canada and South Africa are, or have been, the most considerable importers, and Australia and New Zealand the greatest exporters.

In recent years Canada has imported both butter and mutton in appreciable quantities from Australasia. This trade is favoured by geographical conditions and by direct shipping communication in the same way as any similar trade between Australasia and the United States. Western Canada, as already observed,¹ tends to show a deficiency in animal foodstuffs which—owing especially to the opposition of the seasons—is readily supplied from Australia and New Zealand. This trade may disappear if animal industries are developed more extensively in the Prairie Provinces and in British Columbia.¹

South Africa, till quite recently, was rather a marked deficiency area in animal foodstuffs and in cereals. Its imports of beef, mutton and dairy produce in the period 1909–12 were derived almost entirely from Australia and New Zealand, but those of pig-meat came mainly from the United Kingdom.² The imported

¹ See Part I., Chap. iv., pp. 54, 55.

² These consignments apparently consisted mainly of cured meat from the United Kingdom, imported originally from elsewhere.

cereals, chiefly wheat and oats, were similarly derived mainly from Australasia. Since 1912 it appears that the live-stock industries of the Union have made such progress as to be nearly equal to supplying the home consumption of animal foodstuffs on the balance ; and there may in the future be a considerable growth in the exports of meat which have recently begun to be appreciable. Should South Africa thus become a surplus rather than a deficiency area in animal foodstuffs in the future, the supplies of these articles of Imperial origin available for meeting the deficiency in the United Kingdom should be increased correspondingly.

There is no doubt that for some time to come the numbers of live-stock on the Continent of Europe will be considerably below the normal pre-war levels, and the tariffs hitherto imposed by certain continental countries upon imported meat may be modified, temporarily, at any rate, in order to attract supplies in larger quantities into these countries. It is quite possible that France and Italy, for example, may become for a time extensive importers of frozen and chilled meat. In view of the expansion in meat production in temperate South America, these supplies might conveniently be derived thence, but they may come partly also from the British Dominions for two reasons : the countries of Central Europe may compete vigorously for a share of the South American exports, more especially because the surplus supplies from Holland, Denmark and Sweden will be seriously restricted for some time to come ; and Canada, South Africa and Australia all produce certain quantities of lower grade beef which may find a better market on the Continent than in the United Kingdom, while the latter may at the same time be importing large supplies of better-class beef from Argentina.

The problem of return cargoes constitutes the chief difficulty in the way of the consignment of the whole of the surplus production of the overseas parts of the Empire to the United Kingdom, where the great deficiency occurs. The exports of the United Kingdom consist mainly of the comparatively less bulky manufactured goods, the raw materials for which have themselves to be largely imported. The most striking exception to this rule is coal, the exports of which may be more limited in the future, and which cannot in any case be carried outwards in the ships that are employed in transporting animal foodstuffs homewards. On the great cargo-liner routes between the United Kingdom and the Dominions, there exists, therefore, a constant shortage of return freight for ships on their outward voyages.¹ Frozen meat is a somewhat bulky cargo material compared with general merchandise, and chilled meat is yet more so. This shortage of return cargo would be still more marked if a greater proportion of the deficiency of animal foodstuffs, were supplied from Empire sources under the present conditions, since the most productive of these sources are separated from the

¹ For a clear and detailed account of this subject, see Sargent, *Seaways of the Empire*, 1918.

United Kingdom by great distances. It would appear that for the future the best means, short of subsidies, of maintaining low freights for animal foodstuffs homewards from the Dominions, and of preventing the diversion of part of these supplies to nearer markets will be found to lie in the maximum development of the home-country's exports of iron and machinery to the Overseas Empire. These goods constitute suitable return cargo, are made in the United Kingdom mainly from home-produced raw materials, and are required in great quantities by the Dominions. It is especially regrettable, therefore, that American manufacturers should have captured an important part of the British-colonial trade in agricultural implements and machinery. The present conditions, under which there is a shortage of return freight from the United Kingdom to the Dominions, and likewise from the Dominions to the United States, may prove distinctly unfavourable to the whole of the surplus of foodstuffs from the Overseas Empire finding its way to the United Kingdom.

The case of South Africa is entirely exceptional in this direction. Hitherto there has been a marked shortage of cargo homeward from the Union, and the development of an export trade in meat and maize thence to the United Kingdom is thus distinctly favoured by transport conditions.

The question of freight space does not apply with such force to butter and condensed milk, or even to cheese, as to meat, since these articles are, on the whole, less bulky in proportion both to money values and to food values, than the latter. Partly for this reason, therefore, the British Empire may be able to supply its requirements in dairy produce more completely in the future than in the past.

The requirements of the United Kingdom in animal feedstuffs may increase in the future if more attention is given to animal-rearing, but shipping conditions make it imperative that as large a proportion as possible of the additional requirements should be produced in the United Kingdom itself, if the Empire is to become more self-sufficing in this respect. Although feedstuffs can be transported in bulk, much more cargo-space has to be used in carrying them than in carrying the finished animal foodstuffs in order that the British consumer may have the same quantities of the latter at his disposal.¹ It has been noted in Chapter I., above, that something over 25% of the net deficiency of the United Kingdom in animal feedstuffs in 1913 was supplied from Empire sources. There is good reason for supposing that a larger proportion may be supplied in the future from these sources, if shipping and freight conditions are favourable. The rising wheat production of the Empire, especially in Canada, should cause a greater proportion of the wheat imports of the United Kingdom in the future

¹ This is owing to the fact that from 10–12 lbs. of feedstuffs are required on an average to produce 1 lb. of animal foodstuffs. (See Part II., Chap. v., p. 268.)

to be of Imperial production, and this would mean that a correspondingly greater proportion of the offals obtained from wheat milled in the United Kingdom will be ultimately derived from the Empire. The commencement of an export trade in maize from South Africa in recent years gives ground for hoping that in the future an appreciable part of the Empire's deficiency in maize will be supplied from that source, more especially since, as above noted, transport conditions are favourable. Moreover, there appears to be no essential reason why much larger quantities of tropical oil-seeds and nuts from British West Africa, India, and the Pacific Islands should not be imported in the future into the United Kingdom to be treated there.

By way of conclusion, some of the main points discussed above may now be summarised. In order that the Empire's requirements in foodstuffs and feedstuffs may be covered as far as possible from its own resources, it appears desirable, in view of transport problems, first, that as large a proportion as possible of the feedstuffs required in the United Kingdom should be produced in that country ; second, that its deficiency in feedstuffs should be drawn as far as possible from the nearer sources in the Empire, especially from Canada, while animal foodstuffs, rather than feedstuffs, should be drawn from the more distant agricultural areas such as Australia and New Zealand ; third, that all exports whether of foodstuffs or of feedstuffs from South Africa to the United Kingdom should be developed as much as possible ; and fourth, that much greater use should be made by the Empire of its supplies of tropical oil-seeds and nuts. The surplus production of Canada may be sufficient in the near future to supply the Empire's deficiency in oats and barley, and with that of India, in linseed also. Australia and New Zealand, together with South Africa and Canada, if attention is given to improvements in live-stock, may be able to supply a much greater proportion than at present of the Empire's deficiency in beef, mutton, and dairy products, especially if cheese is used more freely as a substitute for meat, and margarine for butter, in the United Kingdom. There remain the great deficiencies in maize, pig-meat and eggs. That of the former may be lessened somewhat by an increased use of cakes and meals from tropical oil-seeds and perhaps of barley also, while pigs and poultry might be reared in much greater numbers in the most important cereal region of the Empire, namely, Canada. Fortunately, it is precisely in pig-meat and eggs that the United States has, or tends to have, a surplus, so that any additional supplies arising from increased production of these foodstuffs in Canada is not likely to be diverted to the American market.

SOME EFFECTS OF THE WAR UPON THE PRODUCTION AND THE CONSUMPTION OF ANIMAL FOODSTUFFS.

Except at scattered points when some allusion seemed inevitable, little attention has been given in this enquiry to the special circumstances created by the war. For the most part, pre-war conditions have been taken as the basis of discussion, and forecasts concerning the future production, trade and consumption have been made with but slight reference to the new directions which the war may cause in these different aspects of the question of animal foodstuffs, either temporarily or permanently. The prolongation of the war makes some discussion of its actual and probable effects in this matter appear necessary. The general economic propositions above put forth remain, but are subject to some modification in view of the abnormal war conditions. On the whole, however, the effects of the war in such prime and essential matters as the production and the consumption of animal foodstuffs among the white populations of the world, seem likely to be temporary rather than permanent; and in some directions at least, their result will simply be to accentuate the march of tendencies previously in progress.

On the production side the first point that calls for attention is the undoubted depletion of the numbers of food-producing live-stock in Europe in all the belligerent countries and also in some of the neighbouring countries.¹ It is not known exactly how far this depletion has proceeded in the countries of Central Europe or in Russia, but in France and the Scandinavian countries it is considerable.² The worst and most prolonged effects of such depletion arise from the slaughter of breeding-stock, which almost inevitably become reduced in numbers owing to the temptation to dispose of as great a number of mature animals as possible. In Central Europe, from the commencement of the war, and in France, Italy, and the United Kingdom at a later stage, there has been a shortage of feedstuffs, especially of the concentrated kind, and abnormal slaughterings of live-stock have been encouraged in order to relieve the situation in this direction, as much as to provide sufficient immediate supplies of meat for the armies and for the civil populations. In North America, also, since the outbreak of the war, there has been some unusual drain upon the live-stock resources, at any rate of cattle, to provide for increased exports of beef to

¹ See U.S. Dept. of Agric., Report 109, Office of Secretary, p. 68, also *Journal des Economistes*, April, 1916, pp. 81 *seq.*

² In the United Kingdom sheep and cattle have hitherto (till Jan., 1918) declined but little, though the proportion of young animals in the totals are not given, but pigs (which produce more meat per head enumerated than sheep or cattle) have declined seriously.

Western Europe. In the return to normal conditions after the war, the most rapid recovery is likely to take place in pigs, which multiply rapidly, and the slowest in cattle for the reverse reason. It is to be feared, also, that in Europe a considerable number of dairy cattle have been slaughtered for meat, and if this is the case, several years must elapse before the herds of dairy cows in that continent reach their pre-war strength. There may accordingly be a corresponding shortage of dairy produce for some time.

On the other hand, the production of foodstuffs, more especially plant foodstuffs, in some populous European countries has been stimulated through high prices and the virtual protection that war conditions have imposed, as well as through efforts made by the various belligerent Governments to secure the maximum output of foodstuffs from their respective home resources. In some cases the increased production may have been obtained at the expense of the accumulated fertility of the soil, but more generally the method employed has been to use land more for food crops and less for the maintenance of animals. On the whole, there have been developments in organisation and in methods, in the utilisation of labour-saving machinery and in the training of female labour for the lighter operations, that will favour increased agricultural production in the future. This condition is, of course, vital for the re-establishment and further progress of animal industries. The shortage of fertilisers in certain countries during the war period (rendered more acute owing to the depletion of the live-stock) may have caused some impoverishment of soil fertility. However, enormous strides have been made in the output of synthetic nitrates for war purposes,¹ and these, if they continue to be produced, will be available for use as fertilisers when hostilities cease. If they can be produced cheaply, the result will be a great increase in agricultural production, not only in Europe, but throughout the civilised world. The most serious shortage of fertilisers has probably occurred in potash compounds which, when the stocks on hand became exhausted, have scarcely been obtainable for agricultural purposes in countries at war with Germany or cut off from it by the sea-blockade. On the whole, the impoverishment of agricultural land through the lack of commercial fertilisers is not very serious in the long run, and can probably be made good more or less rapidly at the close of the war. During the period of the war the countries of Europe have been more self-sufficing in the matter of foodstuffs than before it, partly by utilising the stored-up fertility of their soils, but mainly through a decreased consumption of animal foodstuffs by the civil populations.

In Europe and North America, in each of which continents the total production of animal foodstuffs is much greater than it is in any other continent,² the dependence of animal industries upon

¹ See Part I., Chap. viii., p. 145.

² Though Europe as a whole is a deficiency region in animal foodstuffs and North America has now a smaller surplus than either South America

crops is very marked, and the second point that calls for remark in connection with the effects of the war is the decline that has taken place in the estimated world-production of all the leading cereals during the early years of the war,¹ in spite of some increase in the population to be maintained. This decline in the production of cereal crops has necessarily affected animal industries adversely, owing to the consequent decline in the quantities of animal feedstuffs available. The disturbance under this head may not last very long after the conclusion of the war, nor indeed during the whole period of the war, since crop-production can be increased under normal weather conditions with comparative rapidity; but if breeding-stock have been sacrificed owing to war conditions the rate of recovery in animal industries will tend to be slower than that of crop production.

A third factor to be noticed is the shortage of shipping space brought about by the war. This will probably continue for some time in the future, and in the meantime the quantities of feedstuffs that can be transported from the cereal regions to those that have specialised in animal industries will be more or less limited. Under pre-war conditions, as has been shown above, considerable quantities of surplus feedstuffs were produced in comparatively new regions, where intensive methods of stock-rearing have made little progress. An indirect effect of the war may therefore be to cause an increase in the production of animal foodstuffs in those more distant regions, since it is cheaper and more economical of shipping space, to transport the finished meats and dairy produce than the bulky feedstuffs; and the stimulus thus given to the establishment of more intensive systems of animal-rearing in these regions may lead to further developments in the future. On the other hand, although cereal production has apparently declined to a considerable extent in Eastern Europe during the war, it has increased noticeably in Western and Central Europe. It is probable that for some time to come Europe as a whole will devote more of its resources to the production of food-crops for human consumption, with some reduction in the production of concentrated feedstuffs and fodders for animals. In this way animal industries in this most important region will be at an added disadvantage in making good their recovery from the depletion caused by the war. The crop shortage of the world cannot, in the long run, be regarded as

or Australasia, the total production of animal foodstuffs is considerably less in the two latter than in either of the former. It is only the smaller populations which allow of the greater surplus quantities. From the world point of view, changes and developments in animal industries in North America and Europe are much more important than those in South America and Australasia.

¹ The total world production of wheat, barley, maize, oats and rye, taken together, is estimated to have been 1,915 million qrs. in 1912, 1,720 million qrs. in 1914, and 1,625 million qrs. in 1916. The most marked decline was in maize, the leading concentrated feedstuff, which fell from 510 million qrs. in 1912 to 445 million qrs. in 1914 and to 396 million qrs. in 1916.

more than a temporary phase; there is no real shortage at present of cereal-producing land throughout the world, but there is now, and there may be for some time after the war, a shortage of the necessary labour in the crop-producing areas, and of the means of transport from them to the centres of dense population and of specialised animal industries. So long as such limiting factors exist, the production and transport of feedstuffs will be sacrificed to that of food crops, the consumption of which will be all the greater if animal foodstuffs are limited in quantity.

It is difficult to estimate at the present time (1918) how the world's mercantile fleets will stand at the close of the war, but there is good reason to suppose that they will be inadequate for the carrying trade required of them. A number of vessels, it is true, will be released gradually from the naval services of the various belligerent powers, but, on the other hand, there will be a great shortage of raw materials in most European countries to be made good from other parts of the world. A considerable arrears, therefore, of carrying trade in raw materials required urgently for manufacturing industries, will demand execution almost immediately upon the conclusion of peace. The pressure upon shipping space in this period after the war may not last very long, because the high freights to be earned will serve as a great stimulus to the construction of new ships, and the capacity of the world's ship-building yards will probably have been considerably increased during the war-period. So long, however, as there is a shortage of shipping space, and freights remain high, the full development of animal industries to their pre-war scale will be distinctly hindered in all those countries that require to supplement their home production of feedstuffs by importations. In the long run, that is, by the time that shipping transport has become normal, it may be that the production of animal foodstuffs throughout the world will have increased through the war conditions of shipping shortage, because, in the meantime, as already noted, animal industries are likely to be more widely established in the more favoured of the newer countries.

A fourth factor is that of the probable extensive emigration from Europe after the war. It is thought that the desire to emigrate will be widespread and strong among ex-soldiers and others, not only in the United Kingdom, but in other European countries as well, though the shortage of shipping accommodation and limited financial resources may hinder for a time the movement of many overseas. On the whole, emigration from Europe is likely to result in an increase in the production of animal and other foodstuffs in the world at large; not only are greater numbers of the emigrants likely to be employed in agriculture in their new homes than if they remained in Europe, but the production per worker is greater both in quantity and in value in the newer countries than in Europe. It has been pointed out above¹ that increased surplus production

¹ See Part III., Chap. ii.

of foodstuffs in the British Overseas Dominions depends mainly upon an increase in their numbers of agricultural workers. This applies also to the countries of temperate South America, and even to the United States. On the other hand, emigrants from Europe to the newer countries tend to adopt the standard of living of those countries as soon as they are established in them. One marked feature of the standard of living, which is common to all new countries, is a high per capita rate of consumption of animal foodstuffs¹; and emigrants from Europe settling in new countries are likely to consume more of these foodstuffs per capita than fell to their share in their old homes. So far as such emigrants take up agricultural work, their contributions, either directly or indirectly,² to the world's production of animal foodstuffs will probably more than counterbalance their increased consumption; but so far as they settle in towns, their consumption may increase, without, however, any corresponding compensation arising on the side of production. The results of any extensive emigration from Europe after the war, therefore, upon the relations between the supply and the demand for animal foodstuffs, turn largely upon whether the majority of the emigrants take up agricultural or urban occupations.

A fifth factor bearing upon the future production of animal foodstuffs is the devastation wrought upon certain productive agricultural districts in Europe which have been the scenes of battles or of the movements of enemy armies. This damage, though by no means inconsiderable, will have affected but a small area compared with the productive area of Europe, and may not prove in most parts to be of a very permanent nature so far as the production of crops is concerned. Indeed, the enforced rest from cropping that the ground so occupied will have been subject to may constitute an advantage when it is once more taken over for agriculture. The destruction of buildings, however, will hinder re-occupation until they are replaced, and the re-establishment of animal industries will thus tend to be delayed longer than that of other forms of agriculture. In this matter much depends upon the arrangements made for the payment of compensation; if the latter is inadequate or is delayed, the work of restoring all such land to full productiveness (without which animal industries suffer) may be further delayed.

A sixth factor, and one of no small importance in this connection, is the disorganisation caused directly and indirectly by the war in the agricultural industries of Russia and Siberia. Attention has been drawn in Part I., above (pp. 82-94) to the enormous surplus of poultry produce, butter, and feedstuffs from Russia and Siberia in the years prior to 1914, which made that region one of the three greatest surplus-producing regions in respect of animal foodstuffs

¹ See Part II., Chap. i.

² Concerning the inter-dependence of all forms of agricultural production, see above, Part I., Chap. xiii.

and feedstuffs combined, in the world. So long as the present disturbed conditions last this export trade is not likely to be properly resumed, to say nothing of its expanding. Although the agricultural resources of Russia and Siberia are enormous, it is uncertain how much time will elapse before the economic life of this region is re-established on normal lines. In any case, it is not likely to be so immediately after the conclusion of hostilities in Europe, owing to the need for renewals in agricultural machinery and railway material.

Finally, the progress of agriculture and in particular of animal industries (which tend, as we have seen, to be residual) may be impeded by a labour shortage not only during the war, but after its close, through casualties in the armies. In all belligerent countries considerable numbers of agricultural workers have been absorbed into the armies, and, in addition to those killed, many more will be injured to such an extent as to be unable to resume the heavy labour required of farm workers. We have seen in the first part of this enquiry that heavy demands for labour are made by animal industries in the present stage of development, and there seems little doubt that these must suffer in consequence of the shortage of trained labour for some time after the close of the war. This difficulty will be counteracted to some extent by the great increase in the number of women trained in agricultural work during the war; and it may prove to be of shorter duration owing to the drifting of numbers of ex-soldiers, who previous to the war were employed in factories and offices, into agricultural occupations.

On the consumption side, certain far-reaching effects are likely to be produced by the war. In all belligerent countries a number of men will be discharged from the armies, who, as soldiers, will have become accustomed to liberal rations of meat—more liberal, on an average, than fell to their lot in pre-war times. This habit of a comparatively heavy consumption of meat they are likely to bring with them when they re-enter civil life, if supplies are available and prices are within their means. On the other hand, among civilians in the belligerent countries there will have been a more or less universal rationing of animal foodstuffs, and, while some will have grown accustomed to the more limited standard of dietary and may not depart much from it after the war, others again, under the influence of reaction, may easily tend to a heavy consumption of these foodstuffs, when restrictions are removed. On the whole, however, the more wasteful forms of consumption will be checked and the habits thus enforced may continue into the future, with useful effects in the economising of supplies. In particular, the waste of meat fats¹ is likely to be reduced as a consequence of the war, partly because of the shortage of such fats that most European countries will have experienced, and partly also because the practice of wasting feedstuffs in the over-fattening of stock will have

¹ See Part II., Chap. iii., p. 231.

been largely discontinued. There is little doubt, also, that the war will have the effect of stimulating the consumption of cheese as a substitute for meat and of margarine as a substitute for butter in a number of European countries.¹

Attention has been drawn previously ² to the effect that an increase in the purchasing power on the part of the working classes in any European community, has normally upon their per capita consumption of animal foodstuffs. In Great Britain, and in some other countries, the war has accentuated the movement already in progress, towards a betterment of the financial status of the working classes. Although there may be some set-back in this direction later on, the democratic tendencies that seem almost everywhere to be in evidence as undercurrents of the war, will, if realised, lead to a further improvement in the position of these classes. On these grounds, therefore, the war may produce a strong tendency in Europe towards an increased consumption of animal foodstuffs among important sections of the population. This tendency may not be quickly realised owing to the limited supplies, but if the demand remains strong enough, the resulting rise in prices, even if not very great, may lead to the production of increased supplies. It is thought by some that European populations will be poorer as a consequence of the war, and this may be true of the communities as a whole without affecting the working classes which constitute the mass of consumers. In this connection it is important to consider three special factors: first, the distribution of incomes among the various social classes; second, the rates of family incomes, which may increase among the working classes owing to the increased employment of women in better paid occupations; and third, the probable continuance of the decline of the birth-rate which, if it extends to any marked degree among the working classes, would have the effect of increasing the purchasing power per family unit.

In the machinery of marketing and distribution the war may bring about developments and improvements affecting the consumer's effective supplies of animal foodstuffs. During the war-period considerable developments have already taken place in the control of the marketing arrangements for all foodstuffs both in Europe and North America, and further progress may be made in this direction with benefits to producers and to consumers alike. In particular, it is possible that the cost of marketing and distributing perishable produce such as animal foodstuffs may be reduced if consumers' interests gain strength under centralised control.

It must be noted also that technical progress in general agriculture and in animal industries has by no means ceased throughout the world as a result of the war. On the contrary, a number of producing countries that have fortunately been entirely free from

¹ See Part II., Chap. ii.

² See Part II., Chap. iv.

the ill-effects of the war have prospered extraordinarily, and have developed their systems of agriculture and animal husbandry, or are in a position to do so ; and in the belligerent countries of Europe the war conditions have forced experiments to be made in new methods of economising agricultural resources, of utilising by-products, and of increasing production which will bear fruit in the future. When the war is over, the energies released from the work of destruction may be devoted more especially to that of agricultural production, where there is still, apparently, great scope for the application of science and of technical improvements.

The quantities of sea fish that will be available for consumption in European countries after the war can probably be increased much above the pre-war level. Not only were the quantities of fish landed in Europe increasing in the years preceding the war, but during the war sea fisheries have, on the whole, been subject to comparatively small drains. At the close of the war the catches may for a time be much greater than in the past. It is possible, therefore, that any shortage in meat supplies may be relieved to some extent by increased fish supplies, provided consumers are willing to make the necessary substitution. At the same time, it is almost certain that, on the pre-war basis of consumption, there will be a distinct shortage of animal foodstuffs in Western Europe after the conclusion of peace, though there is no reason for supposing that this will be a permanent condition.

It remains to be added that the distribution of the exports of animal foodstuffs from the surplus-producing countries may be modified owing partly to the war. Before the outbreak of the war there were frequent agitations in various European countries for the removal of tariffs on imported animal foodstuffs, especially meat, which were successful only to a very limited extent.¹ The shortages caused by war conditions have made importations of meat into both France and Italy necessary ; and there is little doubt that Germany and Austria also, in view of their deficiencies, will import animal foodstuffs from abroad as soon as they are able. To allow of the entry of these foodstuffs, the continental countries in question will have to modify their pre-war tariff rates, and once the change to more or less free importation is made, it may not be an easy matter afterwards to revert to the old protective system. It will be argued, perhaps, in these countries, that producers are sufficiently protected by the higher prices without the aid of a tariff, and that there is no longer any danger of the local market being inundated by large and cheap foreign supplies. Under these conditions there would be a stronger competition than previously existed among deficiency countries for a share of the surplus from the exporting regions, and Great Britain would be no longer practically the only market for animal foodstuffs.²

¹ See Report of British Consul at Buenos Aires, Dec., 1912, p. 26, also Weddel & Co.'s Reports on Frozen Meat Trade, 1901 (p. 17) ; 1905 (p. 6) ; 1906 (p. 13) ; 1908 (p. 5).

² For a fuller discussion of this matter see Part III., Chaps. ii. and iv.

In the years prior to the war increasing quantities of animal foodstuffs were finding their way from European countries and from Siberia to Germany and Austria¹; and it is to be noted that if closer commercial relations are established between the Central Powers and the Russian territory before or after a general peace is made, any surplus of animal foodstuffs and of feedstuffs from this region will be forthwith exported to Germany and Austria, and the trade thus established may continue to the practical exclusion of other deficiency countries. In any case, Germany had become a large customer for Siberian butter before the outbreak of war,² and sooner or later would probably have absorbed the greater part of the Russian and Siberian surplus of animal foodstuffs to meet its growing deficiency.

In conclusion, there is little doubt that the war in several ways will have the effect of increasing for a time the shortage of animal foodstuffs in Europe, that was beginning to be felt before its outbreak; but the situation may be relieved to some extent by an increased use of fish and by a better utilisation of the various kinds of animal foodstuffs themselves, and in the meantime production will be stimulated in the surplus countries outside Europe; moreover, the purchasing power of European populations may for a time be impaired in such a way and to such an extent as to lessen their effective demand for the more costly foodstuffs, in which case the shortage would not be so apparent.

In the long run it does not appear that the war will have any appreciable effect in hindering the progress of agricultural production, and the anticipation remains that, after a period of shortage lasting, perhaps, for a decade, given favourable conditions there will be a comparative abundance of animal foodstuffs for the white populations of the world.

¹ This applied particularly to the surplus from the Scandinavian countries and from Holland, as well as to that of Siberia (in butter) noted below. Practically all the live animals exported from Denmark, Holland and Sweden went to Germany, and Danish butter was finding an increasing market in Austria-Hungary. (See Report, British Consul, Denmark, 1913, p. 5. Germany's imports of perishable foodstuffs were increasing more rapidly than those of the United Kingdom, though the latter were of course still larger. (See *Annales de Géographie*, March, 1918, pp. 112, 113).

² In 1911 approximately 432,000 casks of Siberian butter went to Germany, as compared with approximately 440,000 casks to the United Kingdom. (See Report British Consul at Omsk for 1911.)

BIBLIOGRAPHICAL NOTE.

FAIRLY complete references have been given in the footnotes to the above pages with regard to the sources that have been drawn upon and the authorities consulted. It remains to add some general remarks concerning the more important of these.

The various publications of the United States Department of Agriculture¹ constitute, perhaps, the most complete body of literature in existence dealing with agriculture and the related economic subjects; and they furnish a unique collection of material concerning the branch of animal industries. Many of these publications naturally have particular or exclusive reference to American conditions, but a number of others deal with world-wide questions or with conditions in selected foreign countries, and furnish reliable statistical material collected in a form that it is impossible to find elsewhere. In this connection attention may be drawn to the wealth of up-to-date material concerning the different aspects of the question of meat supplies, which is contained in Report No. 109, issued from the Bureau of Crop Estimates, and which has been largely drawn upon for the purposes of this enquiry. Some of the earlier publications, though now more or less out of date in some respects, are valuable as throwing light upon the conditions that have led to the present situation. The student finds among the mass of publications issued by the American Department of Agriculture material relating not only to the production, movements and consumption of farm products, but also to the technical side of agriculture, the economics of marketing and the science of nutrition.

A mass of valuable information concerning miscellaneous features of the production of and the trade in animal and other foodstuffs is to be found scattered up and down in the United States Daily Commerce Reports from 1910 to date, and in the British Consular Reports; this information often throws a useful light upon the inner processes at work that determine the economic geography in one of its phases, of many regions throughout the world. The former of the above-mentioned periodical publications though excellent in their way and for their purpose, and apparently also quite reliable, are apt, owing to their special form, to appear somewhat scrappy, while, concerning the latter, one often wishes that the accounts given were longer and more detailed. The various publications of the Dominions Royal Commission (Reports and Minutes of Evidence) contain a veritable mine of information concerning questions of foodstuffs in relation to the self-governing parts of the Empire and incidentally also to the United Kingdom.

The geographical factor naturally receives attention in miscellaneous articles in the ordinary geographical reviews, such as the *Journal of the Royal Geographical Society*, the *American Geographical Review*, and the

¹ Those that have more especial bearing upon the subject of the present enquiry are the *Bulletins* of the Bureau of Animal Industry, of the Bureau of Statistics, of the Department of Agriculture, and of the Office of Experiment Stations; the *Farmer's Bulletins* and various numbered Circulars and Reports; and the Animal Industry Reports and numerous special articles in the Yearbooks of Agriculture.

Annales de Géographie, and numerous works dealing with special areas have appeared. Many of the latter are, of course, written from the popular point of view, but, so far as they contain the results of long-continued travel and observation, they are of incidental value as material for serious study of the local conditions in distant lands, more especially if the writers were equipped with some special knowledge or training before commencing their travels. There is, however, a happily growing number of geographical works and regional economic studies that can justly claim to treat their subject in scientific manner, and among those of this class that have been used in the preparation of this enquiry are the *Oxford Survey of the British Empire*, Bon-mariage's *Russie d'Europe*, and Rowntree's work on Belgium. Of the more general works on Economic Geography J. Russell Smith's *Industry and Commerce* is worthy of remark in that it approaches the questions under this subject from a fresh point of view and throws out many interesting suggestions, although one may not always agree with what is said. A valuable work concerning Russia, namely, *Russland's Kultur und Volkswirtschaft*, by Max Sering, has recently appeared, but the book is at present difficult to obtain and was not consulted in writing the chapter on Russia above.

The ordinary British Statistical publications¹ have naturally been used as the chief source of many of the figures in the above chapters; and here it may be stated with all due respect that the manner and form in which the material is sometimes published makes these works more difficult to use and less serviceable than they conceivably might be. The foreign publications in this class are generally less open to criticism in this respect. Among other works containing statistics of production and trade, of the special kind used here, the handy summary tables published by the Dominions Commission as (Cd. 8123) may be mentioned. The Official Yearbooks of Canada, Australia, New Zealand and South Africa contain convenient tables relating to the particular parts of the Empire named, and noteworthy in this respect is the Commonwealth Yearbook in which the figures are given in a detailed and most serviceable form. The *Annuaire Statistique Agricole*, published by the International Agricultural Institute, constitutes an attempt to give figures for the separate countries and for the world at large in a complete summary form, but it appears that some of the data furnished require to be taken critically and with some reserve. With regard to the production and consumption of animal and other foodstuffs, more particularly in the United Kingdom, some very illuminating articles have appeared in the pages of the *Journal of the Royal Statistical Society*.² A number of Parliamentary Papers published during the last twenty years contain, in addition to useful detailed information in the text, series of tables in the form of appendices relating to the special subject of reference.

With regard to economic theory the standard works of Marshall and Schmoller have been followed. In addition, however, numerous articles in

¹ The Annual Returns of Trade and Navigation, the Statistical Abstract for the United Kingdom and that for Foreign Countries, the Annual Agricultural Statistics, published by the Board of Agriculture, and the Annual Agricultural Statistics for Ireland.

² With special reference to animal foodstuffs those under the following dates:—Sept., 1904; Sept., 1907; June, 1909; Dec., 1911; Dec., 1912.

the various economic periodicals¹ bearing upon the subject under study, have been consulted. The American journals are interesting because they attack the questions raised from a thoroughly modern point of view and in a stimulating manner. Some of the articles in them have special bearing upon the subject of agricultural economics in which there is a comparative dearth of standard works.

In the more technical aspects of the question the publications of the United States Department of Agriculture already mentioned are a valuable source of material and have been freely used. Numerous short summary articles setting forth the results of observations, researches and experiments conducted in the United Kingdom and elsewhere are to be found in the numbers of the *Journal of the Board of Agriculture*. The Reports issued by agricultural experiment stations and colleges² in various countries constitute, of course, the fountain head for material in this matter ; but a number of works is now available dealing with the technical side of agricultural production, and some of the more recent Parliamentary Papers are concerned directly or indirectly with questions under this head. For material relating to the science of nutrition, in addition to the researches of Atwater, Langworthy, and others published by the United States Department of Agriculture, some recent publications in England are most useful ; in particular, the Report of the Committee of the Royal Society (Cd. 8421), Professor T. B. Wood's *National Food Supply in Peace and War*, and numerous recent articles by prominent authorities in the scientific and in other reviews. The works of Chittenden and Voit in this department of research are well known, but two short works published abroad during the war-period are of practical interest at the present time ; the first deals with Germany and is entitled *Die Deutsche Volksernährung und der Englische Aushungerungsplan*, and the second with France, namely, Professor Louis Lapique's *Une Politique de Revitaillement*.

¹ *The Economic Journal*, *The Political Quarterly*, *The Journal of Political Economy* (Chicago), *The American Economic Review*, *The Bulletins of Economic Intelligence* (International Agricultural Institute), *The Journal des Economistes* (Paris), *The Revue Economique Internationale* (Brussels) and *Schmoller's Jahrbuch*.

² Among others outside the United States, the Reports of the English and Scottish Agricultural Colleges and of the Rothamsted Experiment Farm, the Reports of the Irish Department of Agriculture and Technical Education, the *Bulletins* of the Canadian Department of Agriculture, the *Arbeiten* of the *Deutsche Landwirtschaftliche Gesellschaft*, and the *Annales de la Science Agronomique*.

INDEX.

A.

- Abyssinia, 105.
 Afforestation, 170.
 Age-constitution and consumption, 250-251.
 Alfalfa, 58.
 Algeria, 95.
 Animals exported from U.K., values of, 19.
 Animal foodstuffs, definition of, 1; supplies of in Middle Ages, 9; supplies of in recent times, 10; improved quality of, 14; specialities of, 32; consumption of and racial vigour, 35; slow growth in total exports, 175; cold storage of, 182; determination of costs of, 187-190.
 Argentina, 56-62, 293; agriculture described, 56, 57; statistics unreliable, 57; live-stock ratios and meat exports, 57; jerked beef industry, 58; alfalfa pastures, 58; meat consumption, 58; productive area, 60; cereals, 60; carrying capacity of pastures, 155.
 Aryans, vigour of, 6.
 Asiatic populations, 35, 224.
 Australasia, live-stock figures, 41; effects of droughts, 42; summary, 80; trade in foodstuffs with Canada, 306.
 Australia, 68-75; productive area, 68; droughts, 69; live-stock figures, 70; exports, 70; population, 72; transport, 72; artesian water, 73; wool, 75; tropical area, 106; consumption of fish, 206; exports of condensed milk, 288; exports to Eastern countries, 305.
 Austria-Hungary, 135-8; live-stock figures, 136; meat imports, 136; egg surplus, 137.

B.

- Barley, how utilised, 158, 159.
 Basic slag, 144.
 Beef, exporting countries, 30; cost of production on ranches, 172; "baby" beef, 214.
 Belgium, 134, 135; special exports, 32; live-stock figures, 135.
 Birth-rate and consumption, 250, 251.
 Bohemia, 136.
 Brazil, 65, 66, 110, 111; rise in meat exports, 66.
 Breeding stock, significance of, 16.

British Columbia, trade in animal foodstuffs, 54; prospects of agriculture, 54, land values, 178.

British East Africa, 107.

British Empire, see Part. III., deficiency in animal foodstuffs, 279, 284-9; deficiency in feedstuffs, 280-2; deficient in butter, 287; deficiency in milk, 288; wool production, 289; live-stock figures, 291; mining industries, 294, 295; meat consumption, 300; fisheries, 303.

British South Africa, 25, 95-97; maize exports, 282; imports of foodstuffs, 306; shortage of homeward cargo, 308.

Buenos Aires, meat consumption of, 58.

Bulgaria, 81, 85.

Butter, chief exporting countries, 30; world's total exports, 208; not economical, 212, 213.

C.

Canada, 49-56; deficiency in butter, 32, 286; ranching industry, 49; dairying on prairies, 49; milk production, cfd., with population, 49; meat production possible in prairie provinces, 49, 55; exports of feedstuffs, 50; areas for settlement, 50; exports of animal foodstuffs, 51; economic structure of, 51; live-stock ratios, 52; sheep, 52; change in butter exports, 52, 53; imports of live sheep and mutton, 52; competition of cereals, 53; growth of dairying, 54; expenses of clearing forest land, 176; output of poultry products, 216; butter exports, 286; live-stock trade with U.S., 288; trade with U.S. in agricultural produce, 305; imports from Australasia, 306.

Capital, supplies of for agriculture, 148-150; charges for increasing, 180-2.

Carbohydrates *v.* fats, 230.

Cattle diseases, 107, 272.

Cattle, international trade in, 30, 31.

"Cattle units" defined, 36; world's totals, 36.

Central America, 108.

Cereals, oil-content of, 230; competition of, 157-163; world's production of, 312.

Chaco, 64.

Cheese, chief exporting countries, 30 ;
substitute for meat, 212.
Chile, 66.
China, 97-101 ; poultry products, 97 ;
nature of agriculture, 98 ; exports,
99, 100 ; Soya beans, 100 ; con-
sumption of animal foodstuffs, 195.
Climate and consumption, 243, 244.
Co-efficients for conversion to feedstuffs,
33 ; for conversion to "cattle
units," 36.
Cold storage, influence of on prices, 182.
Columbia, 109, 110.
Common field system, 10.
Consumption, see Part II.
Co-operative Societies, 149, 183-5.
Corn Production Act, 297.
Cotton, competition of, 167.
Cotton-seed, 167.

D.

Dairy industry, machinery in, 151-3 ;
reasons for increase in, 152, 211 ;
meat joint product of, 263, 264.
Deficient industrial countries, 27, 127-
139.
Denmark, 117-119 ; trade figures, 24 ;
live-stock figures, 118 ; consumption
of foodstuffs, 119 ; trade in food-
stuffs, 117, 118 ; increase in average
milk yield, 118.
Density of population and production,
153-156.
Differential Index Numbers, 17.
Diminishing returns, 141.

E.

Eastern Europe, boundaries, 23.
Edible offals, 203.
Eggs, 214-220 ; production in U.S.,
215 ; calorie value of, 215 ; nature
of demand for, 218.
Elaborating-commercial countries, 25 ;
27, 32, 117-126.
Emigration from Europe, effects of,
200.
Enclosures, 11.
England, carrying capacity of pastures,
155.
Enumerations, defects of, 16.
Europe, favourable to food animals, 5 ;
live-stock figures, 41 ; agriculture,
affected by the war, 311 ; emigra-
tion probable, 313.

F.

Fats and oils, international trade in,
31.
Feedstuffs, definition of, 4.
Fertilisers, 143-5 ; importance of com-
mercial fertilisers, 197.

Fertility, causes of losses in, 144.
Fibre crops, 167, 168.
Fish, not included, 1 ; substitute for
meat in Japan, 1 ; preserved in
primitive times, 8 ; per capita con-
sumption of in Australia and New
Zealand, 206 ; importance of in
diet, 221-3 ; calorie value of, 221 ;
effect of high prices of, 232 ; prob-
able increased consumption, 317.
Flax, 168.
Florida, phosphate deposits of, 145.
Food animals, world's totals, 36 ;
decline in per capita ratios of, 37 ;
consumption of feedstuffs by, 254.
Foodstuffs, definition of animal, 14 ;
standards of consumption, 226, 227 ;
Forests, 153, 169-171.
France, 132-4 ; special exports, 32 ;
trade with Madagascar, 132 ; live-
stock figures, 133 ; exports of pro-
duce, 133 ; meat consumption, 133 ;
imports of meat probable, 134.

G.

Game, meat from in earlier times, 7 ;
as source of food supply, 204.
Germany, 130-2 ; special exports, 32 ;
live-stock figures, 130 ; meat con-
sumption, 130 ; trade in foodstuffs
and feedstuffs, 130 ; decline in
sheep, 131 ; deficiency in dairy and
poultry produce, 131 ; imports of
oil-seeds, 131 ; milk yield per cow,
131 ; deficiency in feedstuffs, 132 ;
beet sugar, 132 ; output of synthetic
nitrates, 145 ; potato crop, 164 ;
imports of Siberian butter, 318.
German South-West Africa, 97.
Goats, decline in importance of, 6.
Great Britain, 128-130 ; monopoly
market for food, 13 ; consumption of
foodstuffs, 128 ; growing deficiency
of foodstuffs, 129 ; mutton con-
sumption, 129 ; value of poultry
products, 216.
Greeks, animal food supplies of, 8.

H.

Habit and consumption, 244-6.
Holland, trade figures, 24 ; live-stock
figures, 120 ; trade in foodstuffs,
120, 121 ; consumption of food-
stuffs, 121.
Honduras, 108, 109.
Horses, used as human food, 2 ; little
used in early agriculture, 6 ; repre-
sent power charges, 143 ; displace-
ment of by motor power, 161, 162,
259.

Hungary, 81, 85, 135-8; exports of cereals, 137.
Hunting become luxury pastime, 15.

I.

Index numbers and prices, 17.
India, 298.
Indo-China, 105.
Intensive methods, 191.
Ireland, 124-6; live-stock figures, 124; exports and imports, 125; consumption of foodstuffs, 126.
Italy special exports, 32.

J.

Japanese, fish replaces meat in diet of, 1.
Joint products, 260-3.

K.

Kainite, 144.

L.

Labour, increased cost of, 178, 179.
Land per head population, 29, 30.
Leather as joint product, 260-2.
Linseed, 168.
Live animals in international trade, 30, 31.
Live stock, numbers and ratios in four continents, 41; value in maintaining fertility, 142; slaughter of breeding stock, 310.

M.

Madagascar, 107.
Maize, 2; how utilised, 159, 160; world's production, 160.
Manchuria, 100.
Mashonaland, 106.
Matabeleland, 106.
Matto Grosso, 111.
Margarine, consumption ascertainable, 203; materials used in manufacture, 209; expansion in output, 209, 210; oils used in manufacture, 210.
Meat, world production of, 1; total exports of, 104; per capita consumption of, 205; calorie equivalent of, 206; stimulating effects of, 228; increase of cereal substitutes, 229; produced incidentally in dairying, 258; cost of in family budgets, 119, 223; future supplies, of, 40.
Mesopotamia, 102.
Mexico, Northern, 101, 102.
Mexico, Southern, 108.
Middle Ages, animal food supplies in,

Milk separator, 131.
Milk, supplies in early times, 6; condensed and dried, 213, 214; required for raising baby beef, 214.
Milking machines, 152.
Milling offals, 2.
Mixed farming, products of, 3
Monte Video, 63
Morocco, 95.
Murray basin irrigation works, 73.
Mutton, chief exporting countries, 30; world's exports, 266.

N.

Newfoundland, 298.
New Zealand, 75-80; productive area, 76; exports, 77; live-stock figures, 78; labour shortage, 79; carrying capacity of pastures, 155; per capita fish consumption, 206; expansion in cheese output, 212.
Nitrate of soda, 144.
Nitrogen, fixation of, 145.
North America, live-stock figures, 41; summary of conditions in, 55, 56.
Norway, production of synthetic nitrates, 145.

O.

Oats, mainly horse feedstuffs, 2, 160; increase in average yields, 163; increase in world production, 160.
Oils, edible, 119.
Oil-seeds, 113.

P.

Paraguay, 64, 65, 111.
Phosphates, natural, 144.
Pig-meat, imported early, 11; chief exporting countries, 31; increase in consumption of, 267; prejudice against, 268.
Pigs, early domesticated, 7; economical converters, 268.
Population, white of the world, 36; meat-consuming of the world, 195-198.
Potash compounds, deposits of, 145.
Potatoes, 163, 164; alcohol from, 164.
Poultry, 161, 214-220; conditions favourable for rearing, 217-219; good converters, 220.
Prices, rise of in U.K., 18; retail in London, 174.
Purchasing power and consumption, 235-243.

Q.

Queensland, 106.

R.

Rabbits as food, 204.
 Refrigeration, effects of, 12.
 Reindeer, 21.
 Rents and costs of production, 177.
 Rhodesia, 106.
 Rice, 116.
 Rio Grande, 65.
 Romans, animal food supplies of, 8.
 Rothamsted, 144.
 Roumania, 81, 85.
 Russia, 81-7; meat consumption in, 199; output of fish, 208; export trade ceased, 314, 315.

S.

Separator, effects of perfecting of, 14; tests of efficiency, 131.
 Sheep, international trade in, 30, 31; efficiency of in farm economy, 269, 270.
 Shipping shortage, 313.
 Siberia, 88-94; productive area, 88; lack of transport, 89; butter industry, 91; poultry industry, 92; exports of butter, 318.
 Skim-milk neglected as food, 250.
 Soil, exhaustion of, 39.
 South America, live-stock figures, 41; summary of conditions in, 66-8; total meat exports from, 293.
 Speculation in land, 178.
 Substitution in consumption, 233, 249, 250, 265-271.
 Sugar beet, 164-7; pulp from, 165, *v.* Sugar cane, 166.
 Sulphate of Ammonia, 144.
 Surplus-producing countries, 26, 43-104.
 Sweden, 32, 122-4; industries, 122; live-stock figures, 123; consumption of foodstuffs, 123.
 Switzerland, 32, 138-140; special exports, 32; deficiency in animal foodstuffs, 32, 138; live-stock figures, 139; industries, 139.

T.

Tankage, 2.
 Timber, supplies of, 169-71; threatened shortage in U.S., 45.
 Trade balance sheets, 27-9.
 Tropical Highlands, 21, 22, 26, 105-113; summary, 112, 113; live-stock figures, 112.
 Tropical Lowlands, 113-6; forests of, 170.
 Tropical Regions, feedstuffs exported from, 21, 26.

U.

Unenumerated meat products, 19.
 United Kingdom, imports of foodstuffs and cereals, 23; decline in imports of live animals, 175; animal foodstuffs consumed, 202; per capita consumption of dairy and poultry products, 206; per capita consumption of milk, 213; excessive consumption of fats, 231; consumption of feedstuffs by animals, 254; deficiency of animal foodstuffs, 279, 284-9; deficiency in feedstuffs, 280-3; emigration to U.S., 292.
 United States, 43-49; deficient in beef, 32; decline in meat exports, 38; overstocking on range lands, 39; surplus animal feedstuffs, 43; meat exports, 43; per capita production of feedstuffs, 43; effects of war upon agriculture, 43, 48; cattle trade, 44; exports of feedstuffs, 44; live-stock ratios, 44, 45; threatened shortage of timber, 45; areas of deficient rainfall, 46; irrigation schemes, 46; population *v.* farm lands, 47; changes necessary in methods, 47; increase in wheat area, 48; increase in cotton area, 48; changes in tariff, 53; rise in value of farm lands, 176; per capita consumption of dairy and poultry produce, 206; production of eggs, 215; importance of poultry industry, 217; capital in animal industries, 254; losses of animals, 272; live-stock trade with Canada, 288; immigration from U.K., 292; trade with Canada in produce, 305.
 Uruguay, 62-4.

V.

Veal, by-product of dairying, 258; economies of production of, 268.
 Venezuela, 109, 110.

W.

Waste and consumption, 246-9.
 Weather, effects of variations in, 18.
 Western Europe, boundaries, 23; population, 23; live-stock figures, 140; decline in meat imports, 141.
 Wheat, 157, 158; world's production, 158; increase in per capita wheat acreage, 157; increase in average yields, 163.
 Wool, as joint product, 260-2; output of British Empire, 289.

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